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NOTES AND COMMENTS.

The Extinction of Wild Animals.

WE were glad to see in the *Pall Mall Gazette*, early in April, an excellent, if somewhat tardy, notice of Dr. Hart Merriam's Bulletin on the American Hawks and Owls. Zoological periodicals, from time to time, attempt to impress upon the public the necessity for concerted effort, to prevent the wholesale extinction all over the world of those animals which interest the sportsman, either directly for their own sakes, or indirectly because they rival, or are supposed to rival, him in his attacks upon game. But, save by publishing an occasional set of letters, on the decoration of the human female by the skins of birds, the general papers take little interest in wild animals. So-called birds of prey form one field in which general papers like the morning and evening dailies might both interest their readers and assist zoologists. Here is another. The extremely interesting and peculiar fauna of Africa is becoming rarer year by year. At a recent meeting of the Zoological Society, African hunters from various parts of that continent were present, and all of them had to tell how animals, a few years ago abundant near the coast, must now be sought a month's journey inland. Will no paper take up the cry "Africa for African animals"? At the least the various European Powers might be persuaded to do something for the indigenous fauna of their vast hinterlands. The hunter is a curious survival of the instincts of primitive man, and it may be that he, too, should have place in the international preserves of Africa. But the mere sportsman must be either suppressed or regulated, else the highlands of Africa will become as devoid of large animals as the heights of Dartmoor.

Lord Lilford on the Preservation of Wild Birds.

On the same subject hear Lord Lilford: "A cry comes up from many parts of our islands," he remarks (in the *National Review* for April), "that many of our native birds are rapidly disappearing."

We regret to have to agree with such a competent ornithologist that the cry is probably well-founded. Interesting hawks and owls are apt to be classified under the simple title of "vermin"; and, in spite of a well-known remark of the late Professor Thorold Rogers, vermin are not as a rule allowed much law. Nor is this antipathy to the winged creation, which justly arouses Lord Lilford's anger, at all confined to the present century; he quotes from a statute of the sixteenth to this effect: "45 item that no person shall suffre no kyte, busserd, pye, nor fleshe crow to brede, and their yonge to fly away from the grownd uppon payne of losing xiid." Presumably the fine was large enough to secure obedience. Nor, unfortunately, does the redundancy of negatives in the above sentence imply an affirmative. There is no doubt at all about the relentless policy ordained.

Lord Lilford alludes to the sparrow in North America. A few years ago, comparatively speaking, there were no sparrows at all in the United States. Now there are so many that a bulky volume has been written to bring home to them their iniquities. And after the impeachment, the sentence is pronounced that the unfortunate birds are to be dealt with by the help of "London purple" and "Paris green." These are, it is perhaps hardly necessary to state, euphemisms for deadly compounds of arsenic. The sparrow has, however, triumphed over these kindly attentions on the part of its hosts; not so the rarer Accipitres of our islands. Lord Lilford makes the honourable boast that he himself has never offered a price for the killing of any bird. We respectfully offer him our congratulations; but it is clear that he is a real *rara avis* among ornithologists. The main claim for distinction in that science, as it appears to us, is to possess the largest possible collection. It is all very well for ornithologists to complain; but they are among the chief sinners, and the blood of most rare birds lies upon their heads.

A propos of the persecution of rare birds so ill-advised as to occasionally visit the inhospitable shores of Great Britain, anyone who takes up those for the most part exceedingly arid catalogues of the birds of a county cannot fail to have been struck by the remark, of not infrequent occurrence, that such and such a rare species is known by one example "shot" at this or that locality. The excuse offered is that the visits are literally flying visits, and that there is no chance of a permanent settlement. This may be true, but it is by no means proved. The birds have had no chance of proving or disproving the allegation. The British Ornithologists' Union comprises nearly, if not quite, all of the ornithologists of this country, and Lord Lilford is its president. If they were to follow the excellent example of the president and resolutely decline to buy any specimen of a scarce bird shot in this country, the supply would cease with the cessation of the demand. At the very lowest estimate no harm would be done by the adoption of such a course. And it is possible that the fauna of the country would be ultimately enriched,

to the benefit not only of the professed ornithologist but also of the lover of birds who is not an ornithologist.

Wild Cats at the Zoo.

Still *à propos*! A writer in the *Spectator* accepts the two reputed wild cats in the Zoological Gardens as genuine specimens of the real *Felis catus*. He may be perfectly correct, and, if so, the Zoological Society is greatly to be congratulated. For the true wild cat will be soon—and, in the opinion of some, is already—as defunct as the dodo. No doubt there are plenty of large and fierce tabby cats to be found in Sutherlandshire, and in other places in the extreme wilds of Scotland; but there is also no reason to hesitate before referring a good many of these to a mixture of the original wild cat with various pussies whom the delights of sport have permanently allured from the domestic fire-side. Anyone who lives in a neighbourhood where there is game, knows how mysteriously grimalkin disappears, to be possibly recognised later nailed to some tree trunk or barn door. We believe that a true character of the wild cat is the entire absence of white hairs about the body. Many cats, most flagrantly domestic, have the black feet and short tail tipped with black of the wild cat; as a matter of fact, there seems to be little doubt but that the domestic cat is of mixed breed like the domestic dog. There is, doubtless, a considerable strain of *Felis catus* to be traced therein, but also some mixture of Egyptian or Oriental breeds. The gamekeeper, who is so praised by the writers of that rapidly-increasing class of book which has been termed "scientifico-literary," is looked upon with abhorrence by the naturalist. Under the heading of "Vermin," it is probable that the last genuine wild cat, if not already extinct, will soon pass away. The author of that delightful book, "The Naturalist in Siluria" (Sonnenschein, 1889), thought he had records of wild cats in Ross; but in the description of the supposed *Felis catus* there is too much of what De Quincey has called "demoniac inaccuracy" to admit of an unprejudiced judgment. When one has the misfortune to come across the carcass of a "wild" cat gracing a barn door, it would be worth while to secure the skull. Dead cats *do* tell tales, for Dr. Hamilton assures us that the skull of the true *Felis catus* is a perfect image in little of that of the tiger, while the domestic cat reveals its Egyptian strain by a much narrower cranium.

The White Rhinoceros.

Some thirteen years ago that mighty hunter, Mr. Selous, contributed to the *Proceedings of the Zoological Society* an excellent paper upon the African Rhinoceroses. Formerly, and chiefly through the energies of the late Dr. Gray of the British Museum, a goodly number of species were believed to exist in that continent. Mr. Selous showed that there were really only two—the

"white" and the "black." The distinctions of previous writers were mainly based upon the varying lengths and the proportions of the horns. The African Rhinoceros "Theodore," until recently alive at the Zoological Gardens, during the course of his long life in that menagerie belonged, on those assumptions, to two, if not three, different species at various times.

At a recent meeting of the Zoological Society, Mr. Coryndon gave some additional and welcome details about the now very rare "white" Rhinoceros. It is curious that this animal should have got the name, for it would appear to be blacker than the "black" Rhinoceros. The question of colour gets more involved from the circumstance that the older writers on the natural history of Africa distinctly speak of it as paler than the black *Rhinoceros bicornis*. *Rhinoceros simus* is now so rare that till quite lately there was only a single specimen in Europe. The Museum which had this unique animal was Leyden. Now, however, that Mr. Coryndon has succeeded in procuring two specimens in Mashonaland, we shall shortly see one at the British Museum; of the other the skin is to be placed in the Tring Museum, and the skeleton has been purchased by Cambridge University. The stuffed skin has been on exhibition at Mr. Rowland Ward's. In our opinion the head of Mr. Rothschild's specimen does not hang quite naturally, but the general effect is good, and the wrinkling of the skin round the nose and at the base of the ears is remarkably accurate. The bulk of the huge beast may be understood from the fact that it took thirty-seven "boys" to carry the skins and skeletons of two individuals. The approaching extinction of the animal is due chiefly to the fact that it cuts up into unusually good beef. The flavour of strange animals is almost invariably said to resemble veal, but this has apparently never been asserted of the white Rhinoceros. Opinions as to the disposition of the Rhinoceros vary. Mr. Selous regards them as not in the least dangerous, except through accident; though a wounded Rhinoceros may charge with terrible impetus, and may thereby produce direful results, he thinks that this is due to confusion and fright rather than to a wish for revenge. On the other hand, there are some who have stated that the Rhinoceroses of Africa are savage in their character.

Mr. Coryndon states that *Rhinoceros simus* stands, when fully adult, at least six feet high at the shoulder; it is, without doubt, the larger of the two certainly known species of Africa. Its main difference from *Rh. bicornis* is the square muzzle and the habit of cropping grass; the black Rhinoceros, on the other hand, has a pointed and slightly prehensile upper lip, which permits it to feed more easily upon the succulent twigs of shrubs.

THE LEPIDOSIREN AND THE MINHOCÃO.

ONE of the most interesting exhibits of the season was made at the same meeting of the Zoological Society held on April 3 last,

when Dr. Günther showed a few examples of the American *Lepidosiren paradoxa*. Considerable doubts in the minds of some people hung over the real existence of an American Dipnoid as distinct from the well-known African *Protopterus*. Dr. Howard Ayers, of the United States, declined to believe in its separate individuality. A few years ago (*Zool. Jahrbucher*, 1887) Dr. Baur emphasised the distinctness of the American from the African fish, and there is now not the faintest doubt about the matter. On all hands, however, it was admitted that the *Lepidosiren* of South America was a rare animal. According to Dr. Baur there were only four specimens of the fish in European Museums in 1887. Since then Professor Giglioli has got others, and the total number is increased by a quantity of specimens in the hands of a London dealer. But all this time in certain districts of Paraguay *Lepidosiren* was a common article of food. Few though the specimens of the *Lepidosiren* were in the Museums of this part of the world (apparently there were none at all in Rio de Janeiro), they succeeded in getting two names: it was attempted to distinguish *L. dissimilis* from *L. paradoxa*. The rarity of the fish induced various legends. It was reported by Saint Hilaire, on the authority of a Brazilian gentleman, that the *Lepidosiren* inhabited the great depths of huge lakes, into the waters of which, like the celebrated Snapping Turtle, it was able to drag horses and horned cattle. The native name was *Minhocão*, which signifies "large earthworm." And a further legend (no doubt derived from the name) shifted the scene of its operations to the soil, from which, as it passed through, it uprooted trees. Nothing more has been recently heard about this terrestrial sea-serpent; but there is no longer any room for doubt that the American *Lepidosiren* is an altogether distinct form from the African *Protopterus*.

In the fish exhibited at the Zoological Society Dr. Günther and Mr. Howes pointed out the curious peculiarity that the hind limbs of the male were ornamented with numerous branched villous processes. Figures of these were subsequently published by Professor E. Ray Lankester in *Nature* for April 12. Nothing of the kind is to be seen in its ally, the mud-fish of Africa.

A Blood-Sucking (?) Earthworm.

Speaking of wild beasts that are at once large, ferocious, and African, a correspondent sends us an interesting note about an earthworm. Africa has already produced the largest earthworm (*Microchæta rappi*) known to science, with the possible exception of *Megascolides australis* from Australia; but these are giants of a perfectly harmless kind. The worm to which we now refer is said, by Mr. Alvan Millson, Assistant Colonial Secretary at Lagos, on the West Coast of Africa, to inspire dread among the natives of that coast. Its appearance is against it: the worm is not only large—three or four feet

—but it is either of a rich, raw-beefy colour or of a lowering black, the difference of colour being a mark of a difference of species. On one occasion a number of natives were collected together when one of these giants strolled casually into the camp; the result appears to have been a rapid flight on the part of the natives. The reason for the awe-inspiring character of the worm is its reputed habit of sucking blood. It does not seem probable that the most recent results of zoological research are known in tropical Africa; but it is a curious coincidence that this research has tended to show that the line of separation between the leeches and earthworms is by no means so wide as it was at one time thought to be. This big earthworm of West Africa inhabits a locality that is remarkable; it does not, as do most earthworms, burrow constantly in the ground, throwing up castings, but lives in deserted hills of Termites.

ANOTHER FORMIDABLE INVERTEBRATE.

Latrodectus formidabilis is an apparently well-named spider which flourishes in Chili to the detriment of any human beings who have rashly interfered with it. The spider is not large as spiders go; it is only 10 *mm.* (not quite half-an-inch) long. But, like many small creatures, its malignity and venom are out of all proportion to its size. Dr. Philippi tells us (*Zool. Garten*, vol. xxxv., no. 2), on behalf of a correspondent, Herr Möhlen, that an unfortunate man, bitten by the Arachnid, lost consciousness in half-an-hour, and was weak in the joints for a month afterwards. Children have been known to be killed by it. The pest is not a rarity either, for in a certain section of country two or three webs were found in every suitable locality that was examined. Another species, closely allied, lives in Spain and Italy. The Chilian spider is "warningly" coloured, with two bright red spots above, and two below upon its black abdomen. As we have noted before, Professor F. P. Borne has an elaborate monograph on this spider; several parts have already appeared in the *Actes Soc. Sci. Chili*.

CONTINUITY IN SPECIES.

ONCE upon a time it was thought an obstacle to the theory of Descent in general, and to evolution by means of Natural Selection in particular, that the gaps existing between genera and between species were so hard to bridge over. Connecting links were absolutely demanded by the theorisers, but the working naturalist was unable to supply them. Let us not be misunderstood! We do not refer to intermediate forms between the larger groups, for these the ingenuity of morphologists soon discovered to exist in almost embarrassing profusion, nor do we refer to such interesting series as that furnished by the ancestors of the horse; but we refer to those minute gradations of form, each inappreciably different

from the one before it, but all constituting a chain that should join, without a single break, two clearly distinct species. Anyone reading the interesting and most valuable book by Mr. Bateson that we review on another page, would suppose that precisely the same difficulty occurred to-day. It is the Discontinuity, as he phrases it, between existing species that has led Mr. Bateson to seek among the facts of variation for some means of overcoming or getting round this initial difficulty; and he thinks that he has found the solution of the problem in a precisely parallel Discontinuity of Variation. In short, *Natura facit saltum*.

Now we are not concerned to deny that discontinuous variations, more commonly known as "sports," often occur; though whether these, under natural conditions, give rise to similarly modified offspring, such as might be held to constitute a new species, or even variety, is a very different question, that has hitherto been answered in the affirmative only in a very few instances. But this also may pass. What we wish now, is to warn our readers against taking this difficulty of discontinuity too seriously. One noticeable form of advance, during recent years, has been the often successful attempt to work out the problem of the Origin of Species in particular cases. This is not to be done by collecting large numbers of co-existing specimens and arranging them in a line. By such methods discontinuity is likely enough to be found even within the limits of a species, as shown in our note on "Mathematical Biology" (vol. iv., p. 83.) The safest, if not the only method, is to take the actual historical facts presented by fossils from successive horizons, elucidating them by the facts of individual growth. It is thus that Beecher has traced the evolution of the species of *Bilobites* (*Orthis biloba*), and that Hyatt and others have been able to connect the species of Ammonites, *e.g.*, *Coroniceras* (NATURAL SCIENCE, vol. ii., p. 279). Even sixteen years ago, in a very remarkable paper on "Transition Forms in Crinoids" (*Proc. Acad. Nat. Sci. Philadelphia*), Wachsmuth and Springer came to the conclusion that the changes between Burlington and Keokuk species "were made by a series of slow and gradual modifications of specific characters, which correspond in a striking manner with the changes in individual life by growth." To this conclusion, which is supported in the paper by abundant detail, they were led through the examination of a previously unworked passage-bed between the Keokuk and the Burlington. Had this never been discovered, or had it not been so fortunately rich in Crinoids, the species of the Keokuk would be still regarded as "discontinuous" both with one another and with their Burlington ancestors.

We cannot give more instances of continuity here. Mr. Bateson, of course, does not dispute them, or if he does, there are plenty more to be found in palæontological literature, especially of recent years. Neither do we dispute Mr. Bateson's instances of discontinuity. But we do wish to suggest that many cases of apparent discontinuity

between species, or examples of discontinuous curves of error within the limits of one species, may be due merely to the fact that we are totally unacquainted with the ancestors of the individuals in question.

FAUNAL SEQUENCE IN EUROPE AND SOUTH AMERICA.

IN recent numbers we have had something to say about the correlation of geological horizons in different parts of the world (vol. iii., p. 404, and vol. iv., p. 8). In this connection, a paper by Mr. W. Möricke on fossils from the Lias and Inferior Oolite of Chili (*Neues Jahrbuch für Min.*, Beilageband ix., 1894) proves of considerable interest. It is astonishing to see how many species are considered to be identical with those of Europe, and still more so to see how the European succession is paralleled on the other side of the globe. Thus, a Lower Lias fauna is indicated by *Arietites cf. rotiformis*, *Spiriferina rostrata*, *Terebratula perforata*, Piette, *Rhynchonella plicatissima* and *R. belemnitica*, Quenst.; a Middle Lias fauna, by *Hildoceras lilli*, *Ægoceras jamesoni*, *Deroceras armatum*, *D. submuticum*, etc.; an Upper Lias fauna by *Harpoceras subplanatum*, *Hildoceras levisoni*, *H. comense*, *Pholadomya fidicula*, etc. In the Inferior Oolite the exactitude of the correlation seems even more remarkable: the Upper Lias strata "are followed by red, sandy limestones, which correspond to the zone of *A. sowerbyi* and *A. sauzei*. Besides *Sphæroceras sauzei* itself, they contain *S. cf. brocchi*, *S. polyschides*, *S. polymerum*, *Hammatoceras* (*Sonninia*) *polyacanthum*, Waagen, etc. . . . These limestones with *A. sauzei* are overlaid by a reddish-brown iron-shot oolite, several metres thick, which is rich in fossils . . . and yields the following species: — *Coeloceras humphriesianum* (d'Orb. *non* Sow.), *C. blagdeni* (Sow.), *Hammatoceras alleoni* (Dum.), *H. gonionotum* (Ben.)," etc. These are considered to indicate the *Humphriesianum*-beds.

It is certainly startling to read of South American species as definitely occurring in the *Humphriesianum*- or *Sauzei*-beds, especially when we remember that the latter have only been recognised in this country within the last few years. It is, however, possible to suggest a doubt as to the correctness of all these determinations and correlations. *Hammatoceras alleoni* and *H. gonionotum*, for instance, belong to a decidedly lower horizon in Europe; while species, as yet unnamed, which might be mistaken for *C. humphriesianum* or *C. blagdeni*, occur in this country in close association with those *Hammatocerata*. Moreover, it may not prove safe to trust these identifications too closely; at all events, fig. 4 of plate ii., which is named *Leioceras subplanatum* (Oppel), shows a specimen differing from that species in numerous points, and rather resembling *Grammoceras fallaciosum*, Bayle.

Apart from these minor doubts, we are fully prepared to learn that the faunal sequence in South America corresponds remarkably with that in Europe. Whether, as a consequence of this, it will be

necessary to allow for the deposition of the strata of any given zone a vastly greater length of time than has hitherto been conceded, or whether Dr. Walther's explanation, quoted in our last number (p. 245), will suffice—these are questions that will soon demand an answer.

The Legs of Trilobites.

In Natural Science for September, 1893, we called attention to the interesting discoveries of Messrs. Valiant, Matthew, and Beecher, which enabled them to give a somewhat definite account of the appendages and antennæ of these extinct crustacea. Dr. Beecher has followed up his account by two more papers, the first of which (*American Geologist*, January, 1894) deals with "the mode of occurrence, and the structure and development of *Triarthrus becki*, and is founded on specimens obtained from the Utica shale (?) of Rome, New York. In this paper the definite structure of the legs of the thorax has been worked out in detail, and shows each limb to consist of "two nearly equal members, one of which was evidently used for crawling, and the other for swimming." "Each limb is composed of a stem, or shaft, with an outer branch (exopodite), and an inner branch (endopodite)." "The precise form of the coxal joint of the stem (coxopodite) has not yet been clearly made out. It is followed by a broad joint about twice as long as wide, which may be referred to the protopodite." Dr. Beecher says: "The final conclusions to be reached from a complete study of the development and structure of these animals can only yet be surmised. It is quite evident, however, that they are related to the true Crustacea."

In the second paper (*Amer. Journ. Sci.*, April, 1894) the structure of the appendages of the pygidium of *Triarthrus becki* is shown to be as follows: "The endopodites preserve their slender, jointed distal portion, but the proximal part is composed of segments which are considerably expanded transversely, thus making a paddle-like organ, the anterior edge of which is straight, while the posterior one is serrated by the projecting points of the expanded segments. These points bear small bundles of setæ."

An Eocene Pteropod.

The identification of a Pteropod in British Eocene strata is of considerable interest, when we remember that no less than six species are known from similar beds in the Paris basin. Mr. G. F. Harris gives a description and a figure of the new form, which he names *Euchilotheca elegans*, in the *Proceedings of the Malacological Society* (vol. i., no. 2). The specimen is incomplete, was found at Bracklesham, and belongs to the well-known Edwards Collection in the Natural History Museum. In the same journal, Mr. R. B. Newton redeems in part a promise

made in his Systematic List of the Edwards Collection, by describing, in conjunction with Mr. Harris, several of the molluscan species recorded under *nomina nuda* in that Systematic List. We hope that these authors will continue the good work now begun, and rid scientific literature of a mass of names which are of no value and should never have got into print. An excellent point in these descriptions, is the placing of n. sp. (new species) after the names where given, and so making it clear that this is the first occurrence of the new specific name in literature.

AIDS TO GEOLOGISTS.

IT has often been our duty to criticise geological and palæontological text-books with a certain severity, and we have lamented the want of a good elementary text-book of palæontology in the English language. We, therefore, take the more pleasure in directing the attention of students to the second edition of Professor Cole's very useful "Aids to Practical Geology" (8vo. London: Griffin & Co. Price 8s. 6d.) It is true that this does not pose as a text-book, is indeed intended to supplement the text-book, but for all that it will prove more reliable and intelligible than many more pretentious manuals. The style is clear, the figures truly illustrative of the text, the examples of genera on the whole well chosen, the information commendably up to date, and the views of the more advanced as well as of conservative workers prudently set forth. As the first edition was, we believe, stereotyped, there are not many alterations in the body of the text, but this edition has been brought up to date by the insertion of notes in smaller type. As a rule the English student has to rely on foreign text-books in these branches of science; but this is a case in which we honestly think even the Germans might do worse than translate from us. We also take this opportunity of recommending to students, and indeed to all geologists, the thoroughly practical work of Mr. W. H. Penning, "A Text-book of Field Geology, with a section on Palæontology by A. J. Jukes-Browne" (Stanford), which has for some time been out of print. A second edition, however, has just been re-issued, with the addition of a chapter on Pioneer Surveying, chiefly illustrated by South African instances. It is a pity that the whole work could not have been brought a little more up to date, and issued as a third edition; but even in its present form, it is the best of the kind available.

FOSSIL PALM-FRUITS.

IN a recently-published monograph of the genus *Nipadites* (*Journal Linnean Society*, vol. xxx., p.143), Mr. Rendle figures a fine specimen of these fossil palm-fruits from the south coast. It measures five inches by four and a half, and is by far the finest example yet found in this country. For its discovery we have to thank Mr. Clement

Reid, who came upon a number of the fruits on a newly-exposed portion of the beach at West Wittering, near Selsea, in West Sussex, and who has since seen it at Hengistbury Head in Hampshire. More than fifty years ago, James Scott Bowerbank, the founder of the genus, described a number of species from the London clay at Sheppey; these are of various sizes, from that of an almond fruit upwards, but are all smaller than the specimens now in question, which closely resemble those found, often enclosed in concretionary nodules, at Schaerbeek and Woluwe, near Brussels. The only living representative is *Nipa fruticans*, a dwarf palm confined to the brackish estuaries and sea-board marshes of India and Malaya as far as Borneo, New Guinea, and the Philippines. The fruits are borne in large heads, and when ripe drop into the water, where they may float for some time. It is of interest to note that many of the fossil fruits are much bored by *Teredo*, showing that they also floated before becoming water-logged.

Anatomy and Plant Classification.

We would refer our readers to last month's number of the *Journal of Botany* for an able review, by Mr. C. B. Clarke, of the recently-issued volume of De Candolle's "Monographiæ Phanerogamarum," vol. viii., comprising the Guttiferæ, and the work of Julian Vesque. A novel feature is the wholesale use of anatomical details, special importance being assigned to the histological characters of the leaf. As the reviewer observes, the anatomical structure of leaves is rapidly altered by the environment, moisture, shade, and warmth. Hackel, a most painstaking and competent worker, could make no use of it in the grasses. Anatomical, like all other characters, have a variable value, and "are only one among a large number of other characters at least equally entitled to weight. Therefore, anatomical characters are not to be given a superior value, and to be allowed to swamp all other considerations, any more than the number of the stamens. There is no reason to suppose that the anatomy of the leaf is a better clue to the affinity of the plant than the position of the ovule." Mr. Clarke refers to Dr. Palla's revision of the genus *Scirpus*, where the attempt at a classification on a single character, the anatomy of the stem, has brought together plants from the whole range of the large tribes Cypereæ and Scirpeæ, which, though otherwise very different, display similar stem-characters. Happily, Mr. Vesque has not done this. His characters from leaf-anatomy are strictly subordinated to the general weight of all other characters, and "the utmost that can be said against the anatomical method, as introduced by Mr. Vesque, is that it makes his book 15 per cent. heavier than it otherwise would be; it does not make it more troublesome to find other matters."

An instance of the limits to the use of anatomy in the classifica-

tion of plants is supplied by a paper by Miss Smith in the last issue of the *Journal of the Linnean Society* on the anatomy of a plant from Senegambia. The plant is one of striking and unusual appearance, but has neither flower nor fruit; and suggestions as to its affinity ranged from Lycopods and Conifers to Melastomaceæ, Acanthaceæ, and Thymelæaceæ. In plain English, nobody could make it out. Examination of the internal structure of the stem revealed the fact that it belonged to the Dicotyledonous division of flowering plants, while, according to the author, the occurrence of islands of soft bast tissue in the wood, and groups of phloëm at the periphery of the pith "considerably narrows down the systematic limits within which the plant must come." This notwithstanding, Miss Smith is doubtful whether its affinity is with the Loganiaceæ, Acanthaceæ, Peneaceæ, Gentianaceæ, or Melastomaceæ—a somewhat wide range —or even with any of these families.

THE PRESERVATION OF HERBARIA.

BOTANISTS who dry plants may be glad to know of a time-saving device suggested by C. Michener in *Erythea* (March). Elsewhere, as in the climate of San Francisco, the problem is, how to dry your driers? for given a good supply of dry warm driers the rest is easy in comparison. The method described is as follows: In one corner of each drier, about an inch from its edges, a brass eyelet is inserted; through the eyelet is run a piece of light strong fish-line twenty-five to thirty feet long. On each line are strung from seventy-five to one hundred driers, which are kept from slipping off by a small iron ring at the ends of the cord. The eyelets are of such a size that the cord slips through them easily, and is no hindrance to using the driers, which remain strung during the whole operation, while laying the plant piles, changing the driers, and drying them. The outdoor part of the apparatus consists of several upright posts about thirty feet apart, into which hooks are screwed at every two feet. To dry a set of driers, the rings at the end of the cord are slipped over the hooks, and the driers distributed along the cord. Two posts can carry three or four lines, stretched one above the other. To bring the driers in, and get them into a pile ready for the next change, it is only necessary to push them along the line till they are in contact, and then unfasten the rings from the hooks. The author claims these advantages for his method: it does away with half the labour of spreading the driers to dry, and nine-tenths of the labour of picking them up when dried; both sides of the drier are exposed, and hence they do not come in contact with any surface, damp from dew, frost, or moisture; and the length of time required to dry them is also reduced. In the case of a sudden shower, the driers can be very quickly brought in, and there is no danger of their being blown away.

Recent Researches in Botany.

One of the early numbers of Natural Science contained an account of Treub's researches into the embryology of the genus *Casuarina*. So many new and important facts were brought to light in the course of his work that Treub was impelled to separate the family Casuarineæ, which this single genus constitutes, from the apetalous group of Dicotyledons, where it had hitherto been placed near the Cupuliferæ, and make it the sole member of a new class of flowering plants. This new class he named *Chalazogams*, the rest of the Phanerogams forming one great class of *Porogams*, the main distinctive character being the mode of approach of the pollen-tube to the embryo-sac in the process of fertilisation. In the second class the tube followed the normal course, namely, down the micropyle of the ovule, and so directly on to the top of the embryo-sac; but in the Casuarineæ an indirect route was taken, the tube passing along the side of the ovule down the chalaza, and entering one of the many macrospores or embryo-sacs at the lower end. Other points of interest in the embryology of this anomalous genus were the existence, not of a single macrospore, but of a number, which formed a sporogenous tissue, and of which several might develop very considerably; the presence of long tails to the developing macrospores, up which the pollen-tube ultimately made its way; the frequent appearance in the sporogenous tissue of pitted cells (tracheids), for which Treub could suggest no function; the branching of the pollen-tube, with the formation of recurved blind endings; the absence of antipodal cells in the embryo-sac; and finally the early assumption of a cell-wall by the egg-cell before the arrival of the end of the pollen-tube in its neighbourhood.

In the *Transactions of the Linnean Society* (2nd series, Botany, vol. iii., p. 409), Miss Benson now describes the results of some work on the Embryology of the Amentiferæ which, following on the above, are of great interest and importance. In the first place, she shows that it is no longer possible to classify merely the Casuarineæ by themselves as Chalazogams, for in the alder, birch, hazel, and hornbeam the pollen-tube takes the same indirect route, while there are other points of agreement between the strange Australian genus and our British catkin-bearing trees. Thus, whereas in the normal type hitherto found to be almost universal among Angiosperms, the macrospore originates from one of a single "axile row" of cells (archesporium), in the genera studied by Miss Benson a large number of such rows was present, forming a sporogenous tissue, in which, moreover, spindle-shaped cells frequently arose, developing, in the case of *Castanea*, into large and conspicuous tracheids. The prevalence of "cæca," formed by the embryo-sac, recalling the "tails" of the macrospores in *Casuarina*, is remarkable, as is also the branching of the pollen-tube and the formation of recurved endings.

These points of agreement are, however, "so mixed up with striking distinctions," that, so far, the author cannot claim to have found a counterpart to the extraordinary facts recorded by Treub. "We know nothing of an embryo-sac without antipodals, for they are present and very conspicuous in the British Amentiferæ. In *Betula*, *Alnus*, and the Cupuliferæ I have observed the fusing of the polar nuclei, and in every genus the presence of synergidæ and a *naked* egg-cell."

Miss Benson, in continuing her work, hopes to find some clue to the solution of the vexed problem of the homology of the antipodal cells and the fusion of the polar nuclei of the embryo-sac.

THE four papers contained in the first instalment of volume viii. of the *Annals of Botany* are somewhat diverse in origin. The first, by Professor Campbell, hails from California, and includes the result of some work on the development of *Marattia Douglasii*, the author having been fortunate in finding a large number of very young plants, and also the prothallia and embryos, while collecting in the Hawaiian islands two years ago. Professor Campbell claims to have shed more light on the position of the Marattiaceæ and the origin of Eusporangiatæ from the Bryophytes. Points of resemblance between the sexual generation of *Marattia* and the Liverwort *Anthoceros* are adduced in support of this descent.

In the next, Mr. H. H. Dixon describes his researches on the fertilisation of the Scotch Fir, carried out in the Botanical Institute of the Bonn University under Professor Strasburger's supervision. It is found that in *Pinus silvestris*, as already shown for the Yew by Belajeff, the nucleus of the pollen-tube is not the one efficient in fertilisation, as was formerly believed to be the case in Gymnosperms. As Strasburger had previously demonstrated, in Angiosperms this nucleus is asexual, the male sexual nucleus arising from one of the cells originally behind the nucleus of the pollen-tube. In the Scotch Fir a pair of cells borne on a stalk-cell are formed as the result of a few cell-divisions on the side of the pollen-grain opposite the point from which the tube emerges, and it is the nucleus of one cell of the pair which is sexually functional. The author traces their separation from the stalk-cell and passage down the tube, in which they are pursued and ultimately passed by the nucleus of the stalk-cell, which then becomes indistinguishable from the original nucleus of the pollen-tube. All four nuclei pass into the female cell, their path through which can often be traced by the grains of starch which enter at the same time. Only one of the pair of nuclei unites with the female nucleus, the other remaining in the protoplasm with the two asexual nuclei from the pollen-tube. In the Angiosperms, where a similar division into two similar sexual cells occurs, Strasburger was able to observe in one case the fertilisation of an oosphere by the two nuclei, indicating that both cells are truly sexual. It is suggested that the formation of two sexual cells in *Pinus* came about when the branching of the pollen-tube, which

the author observed, was the rule, there being some probability of two branches reaching different oospheres. The author was unable to demonstrate a perforation of the pollen-tube, as Karsten has recently done, in the genus *Gnetum*, though the apex was often seen to be provided with a deep pit.

Mr. Farmer contributes the only indigenous paper—some studies on Liverworts, in which the histology of the nucleus is discussed in some detail. The last communication, by Mr. G. T. Peirce, is dated from Leipzig, and is a somewhat exhaustive account of the mode of twining of the dodder, including its response to geotropism and other external stimuli, and the mode of growth and penetration of the suckers into the tissue of the host-plant; in the last process chemical activity is found to take part.

Antarctic Explorations.

On p. 234 of our March number, we called attention to the efforts of the Scottish Geographical Society to awaken interest in Antarctic problems. We have now to record a paper by Dr. John Murray in the *Scottish Geographical Magazine* for April, entitled "Notes on an Important Geographical Discovery in the Antarctic Regions." The Norwegian schooner "Jason," Captain Larsen, while looking for seals, in November last year, found a comparatively open sea to the south of Louis Philippe Land and Joinville Island, and proceeded down along the margin of Antarctica to 68° 10′ S. latitude. This is over three degrees further than Ross's 1843 limit, and deserves the importance assigned to it by Dr. Murray. Some new islands were discovered by Captain Larsen at a point near 65° 7′ S. and 58° 22′ W., two of which were active volcanoes; and to these were given the names of "Sarsoe" and "Jason." The latitude reached by this sealing schooner was not so far south as that reached by Weddel in 1823, for he penetrated past the 74th meridian; but its interest lies in the fact that, in this last exploration, the margin of the land was followed the whole way, and thus nearly 300 miles of the southerly extension of Antarctica have become known to us.

In giving publicity to this interesting record, Dr. Murray points out what additions can be made to our geographical knowledge by a small sealing schooner, and urges the importance of a British expedition, properly equipped, and provided with steam-power, to investigate the geographical and natural history problems awaiting solution. We are glad to read that Captain Larsen left the Falkland Islands on the 17th January for another trip to the south, and we trust that this hardy seaman will have further discoveries to announce on his return home.

Johns Hopkins' University.

As we dealt largely in the April number with various English institutions, it is interesting to compare with them an institution in

America that combines many of the features scattered among various bodies in London. This institution is the University founded in Baltimore by Johns Hopkins, who died in 1837. The University Circular for February of this year contains an account of the foundation for the twenty years now completed, written by the President, Daniel C. Gilman. The aims of this University were formulated in an inaugural address by the President, as follows:—"An enduring foundation; a slow development; first local, then regional, then national influence; the most liberal promotion of all useful knowledge; the special provisions of such departments as are elsewhere neglected in the country; a generous affiliation with all other institutions, avoiding interferences and engaging in no rivalry; the encouragement of research; the promotion of young men, and the advancement of individual scholars, who by their excellences will advance the science they pursue, and the society where they dwell."

After paying a tribute to members of the academic staff, Dr. Gilman writes:—"The first requisite of success in any institution is a body of professors, each of whom gives freely the best of which he is capable. The best varies with the individual; one may be an admirable lecturer or teacher; another a profound thinker; a third a keen investigator; another a skilful experimenter; the next a man of great acquisitions; one may excel by his industry, another by his enthusiasm, another by his learning, another by his genius; but every member of a faculty should be distinguished by some uncommon attainments and by some special aptitudes, while the faculty as a whole should be united and co-operative. Each professor, according to his subject and his talents, should have his own best mode of working adjusted to and controlled by the exigencies of the institution with which he is associated."

About some Little-known Molluscs.

For many years past conchologists have been accustomed to reckon the three marine genera *Siphonaria*, *Gadinia*, and *Amphibola* as Pulmonates, despite certain striking peculiarities in their anatomy, on account of the common possession of a pulmonary cavity, supplemented, it is true, in the case of *Siphonaria*, by a gill.

In 1892, however, Haller showed that the last-named was, in point of fact, an Opisthobranch, and its true position next to *Umbrella*. Just lately Plati has come to the conclusion, from a careful investigation of *Gadinia*, that it, too, is an Opisthobranch, so that only *Amphibola* is left with the Pulmonates by Bouvier, who studied it in 1892.

I.

Continental Growth and Geological Periods.

(*Continued from p.* 298.)

Persistency of Drainage Lines.

THE ideas and considerations dealt with in the preceding part of this article bring us naturally to what is taking place in our own time. Since the Tertiary upheavals new lines of drainage and channels of erosion have been established, by which the waste of the land has been and is conveyed to the lowest levels, which are generally, but not always, in the ocean. That is to say, in some cases the drainage lines terminate in inland seas or hydrographic basins, in which the evaporation exceeds the rainfall. Such are the Aralo-Caspian basin and the Central Asian basin[11] in which are situated Lakes Balkash and Alakul, the Great Salt Lake and other areas in North America. Mediterranean seas, connected by an outflow or inflow, or both, like the Black Sea and the Mediterranean, bays such as the Gulf of Mexico, the Gulf of California, Hudson's Bay, etc., also receive their quota of sediment.

Though the general levels of the Continental lands have fluctuated, the main drainage lines—established and deeply cut into the strata they traverse—seem to be very persistent, so that the waste of a large part of the North American Continent has travelled down the Mississippi to the sea since Tertiary times. Similarly, that of the South American Continent has followed the lines of the Amazons, La Plata, and Orinoco, while that of the western area of both continents, cut off by the divide of the Andes and Rockies, extending from south lat. 50° to north lat. 70°, has perforce been cast into the Pacific Ocean or the embayments connected with it.

In the Continent of Africa the Congo delivers its load into the broad Atlantic, almost opposite to the Amazons, with a flood almost equal to, if not superior to it. The same persistence is seen in the rivers of Europe and Asiatic Russia and the Northern portion of North America delivering into the Arctic Ocean, and in the great rivers of China flowing eastward into the shallower eastern seas. These lines of drainage, as I have sought to show in the "Origin of Mountain

[11] *See* the "Physical Conditions of the Aralo-Caspian Region," Wm. Hewitt, Pres. Address L'pool Geol. Soc., *Proceedings*, 1892-3.

Ranges," have become fixed in their positions through the upheavals of mountain ranges; and the modifications they have undergone in their courses have been mainly confined to the hydrographic basins in which they exist, the most fluctuating portion of the rivers being on their own deltas. In cases where the levels of the watershed may not have been very marked, alterations of the drainage basins themselves have arisen through differential subsidence or elevation. Changes such as have been noted in the Oxus and Jaxartes in Central Asia have hardly involved a rearrangement of drainage basins considered on the large scale. The Ganges and Brahmapootra have rolled their floods into the Bay of Bengal since the final upheaval of the Himalayas. But it is unnecessary to multiply these instances.[12]

A FUTURE PERIOD.

It is now time to ask ourselves what is the meaning of this constancy and the persistence of these important physical features. Though differential subsidence and elevation on the large scale are marked on the one hand by raised beaches on the land, and on the other by deep-cut river beds below the level of the sea, as in the Congo and the great rivers on the North American Continent, what may be called the rugosities of surface represented by mountains never disappear excepting by denudation. Further rugosities get developed by faulting and mountain elevation in the locus of mountain ranges, by a persistence of the movements which have initiated them; but the great levellers, the waters and the atmosphere, with their combined chemical and dynamic action, bring their materials again under the displacing action of gravity, whereby, like water itself, they finally find their lowest level. Hence sediments accumulate and have been accumulating through Quaternary time, and were these actions to continue long enough without compensatory elevation, the whole of the land, as has been pointed out again and again, would disappear. On the other hand, were compensatory elevation to go on long enough, the whole of the sedimentary deposits would be stripped from the land, and we should be permitted to see what no one is certain he has ever yet seen, that is, the original crust of the earth.

It thus appears that, though these denudations are of long continuance, they must in the course of geologic history come to an end, for we find most of the land-areas covered with sedimentary deposits.

It follows, then, if the geologic history of our planet is to continue in the form in which it has done in the past, and not to terminate in stripped land-areas or universal levelling, that the sediments on the coasts and seas bounding our continents, which have been accumulating since Tertiary upheavals, must be themselves eventually raised above the waters, and joined on to the dry land. In what way has

[12] Ramsay's "River Courses of England and Wales," *Q.J.G.S.*, 1872, and "On the Physical History of the Rhine," *Royal Instn.*, 1874, may be studied with advantage in this connection.

this occurred in the past? If we ascertain correctly, it will be the key to the future—a truly geological prophecy. That there is a relation of cause and effect between subsidence, sedimentation, and subsequent upheaval, it has been my object to point out in the "Origin of Mountain Ranges." In development of this idea, I seek to show how, as a consequence of this action and interaction, the earth's strata come to be divided into rock-groups containing distinguishing fossils and having each its characteristic lithological grouping, which we know as Periods.

If a great group of physical features lasts throughout vast eons of time, such as I have shown has happened even during the Quaternary period (which we are living in now, and which is likely to continue much longer), it is evident that the deposits will have a characteristic lithology—looked at in the large way—and a fossiliferous *facies* will distinguish them from the Tertiary and preceding rock-groups. Representatives of the modern mollusca and the vertebrate and mammalian fauna and of the modern flora will be here and there embalmed to give further distinction to the strata and joy to future geologists. Among these fossils, works of art and fragments of ships, together with bricks and clinkers from ocean steamers, such as even now are occasionally dredged up in the Atlantic, will be a feature. I understand that when soundings come up with cinders attached to them the heart of the mariner rejoices, knowing that he is on beaten tracks, if so inappropriate a phrase is allowable in ocean navigation. Truly, if the world continueth through another geologic period, and there seems no reason to assume that it will not, as the internal forces are still alive making for rejuvenescence, the Quaternary will be the most distinct and remarkable period of all. Not only will the remains of man and his works up to the present be embalmed, but also those works still in the potentialities of the future to which we may, considering the progress of the last fifty years, look forward with mysterious expectation, if not awe. The future great period will include the present and terminate with the completion of the Quaternary.

Sediments of Existing Seas.

If the preceding reasoning has any cogency in it, there must exist on our coasts, at the mouths of the great continental rivers, enormous sedimentary deposits laid down since the close of the Tertiary. The denudation of the land since then, though late in geologic time, has been enormous. Whole areas have been stripped of their Tertiary covering and in mountain districts thousands of feet of strata removed. To go no further than our own isles, the Tertiary rocks that remain are but a fragment of what once existed.

The Miocene rocks of Antrim, Staffa, Eigg, Rum, and Skye consist chiefly of lava flows and ashes of great terrestrial volcanoes, which fill up the undulating valleys of the Chalk in Antrim, and those of Oolite and Silurian gneiss in what is now the West of Scotland.

According to Ramsay, these islands formed part of a "vast continent, to which the British Islands were united, and which, embracing Iceland, spread far to the north and west into the area of what is now the Atlantic, and on the south was united to Africa, when as yet the Mediterranean had no existence."[13]

Long before the extreme denudations represented by these fragments of a once continuous sheet took place, old rivers intersected this ancient land and scooped out valleys in the Miocene lavas and hills, which were again partly filled by torrents of basalt and obsidian. "Thus it happens that in the old volcanic plateaux, valleys a thousand feet deep have been excavated, and the whole region has by denudation been changed into a line of fragmentary islands the high sea-cliffs of which attest the greatness of the waste they have in time undergone."[14] Sir A. Geikie[15] says, speaking of Eigg, "Lastly, from the geology of this interesting island we learn, what can be nowhere in Britain more eloquently impressed upon us, that, geologically recent as that portion of the Tertiary period may be during which the volcanic rocks of Eigg were produced, it is yet separated from our own day by an interval sufficient for the removal of mountains, the obliteration of valleys, and the excavation of new valleys and glens where the hills then stood." Though we may not claim all this denudation for Quaternary time, since much of it may have taken place during the Pliocene with resultant Pliocene rocks now sunk beneath the sea, these quotations from eminent geologists may well serve to give us an inkling of the powers we are dealing with. According to Dana, the length of the Quaternary period up to now is one-third of the Tertiary.[16] This is but an approximate guess, but nevertheless a valuable one.

Turning our attention to North America, we may say that the Mississippi is at least as old as the Quaternary, and probably very much older. The elevation of the Rocky Mountain regions compelled the drainage of the continent to take a south-western course, while the older land of the Laurentian Highlands and the Appalachians blocked it from direct connection with the Atlantic except in the northern portions. It has been shown that since the elevation of the Uinta Mountains, which began in Cretaceous times, $3\frac{1}{2}$ cubic miles of rock have been removed from every square mile of their surface.[17] A large area of the central Mississippi Valley is occupied with Cretaceous rocks, while the southern part, bordering the Gulf of

[13] "Physical Geology and Geography of Great Britain," 5th ed., p. 263.

[14] "Physical Geology and Geography of Great Britain," 5th ed., p. 356.

[15] "On Tertiary Volcanic Rocks," *Q.J.G.S.*, vol. xxvii., p. 310.

[16] "Manual of Geology," 2nd ed., p. 586.

[17] "Origin of Mountain Ranges," p. 243. In a most interesting paper by Dr. Andrew Lawson, entitled, "The Post-Pliocene Diastrophism of the Coast of Southern California" (*Bulletin* of Dept. of Geol. University of California), it is shown that Pliocene sediments of over a mile thick, called the Merced series, were laid down on the Californian coast. This is an extraordinary example of the accumulation that has taken place in only the closing phases of the Tertiary period.

Mexico, is Tertiary (Eocene and Miocene), and a smaller portion consists of Quaternary deposits. This would seem to show that for a considerable period of time after the upheaval of the Rocky Mountain region continental conditions prevailed over this area, and that the sediments from its erosion and waste now lie at the bottom of the Atlantic.

Unfortunately we cannot read the earth's history with any fulness or accuracy. We may only see as through a glass darkly, but still we are justified in concluding from a consideration of these examples, which could be multiplied from well-nigh all the known world, that an enormous erosion of the land has taken place during the Quaternary period, and that these sediments, probably with those of an earlier period, now lie on the ocean floor, are still accumulating, and will accumulate until such time as the earth's living forces bring them up from below the waters to take their place as mountain, plain and valley in the unceasing cycle of the earth's changes.

Conditions of the Earth's Crust in which Sediments Accumulate, and Rate of Accumulation.

The conditions of the crust of the earth upon which these sediments are being laid down are as varied as the sediments themselves. While in the north-eastern portions of North America, from New York to Baffins Bay, there are no evidences of volcanic activity either in the present time or late geological past, south of New York we gradually approach a volcanic and earthquake area, crossing the Gulf of Mexico, and culminating in Central America. The West India Islands give frequent evidence of volcanic instability by the raised coral formations which are there met with, together with foraminiferal deposits considered to be of deep-sea origin.[18] Within this basin-shaped and almost closed Gulf of Mexico, deep-sea oozes are being laid down, and into this area, at one locality or another, the Mississippi has delivered its daily burden of sediment through, at least, Quaternary time. These spoils of the continental land will probably be interbedded with the lime deposits worn from coral reefs and with the more purely oceanic accumulations of foraminifera and other deep-sea forms of life.[19]

Fluctuations of level of the Mississippi mouth and valley may have given the terrigenous deposits a wider distribution than what obtains now. Borings in the Mississippi Valley show a subsidence of at least 630 feet at New Orleans.

If the land were upraised so as to represent the physiography of the time of this elevation, the sediments now being brought down this great drainage channel would be delivered further into the

[18] "On the Elevated Coral Reefs of Cuba," W. O. Crosby, *Proc. Boston Soc. of Nat. Hist.*, vol. xxii. ; "The Geology of Barbados," Jukes-Brown and Harrison, *Q.J.G.S.*, 1892, pp. 170–226.

[19] *See* three letters by Alex. Agassiz—"On the Dredging of the U.S. Steamer 'Blake,'" *Bull. Museum of Comparative Zoology, Harvard*, vol. v., 1878.

Mexican Gulf. Likely enough in portions of the Gulf in time past there may have been outflows of lava on the sea-bed. Volcanic intrusions in the form of sheets insinuated between the sedimentary beds are another form in which it is highly probable these inland igneous forces have developed themselves. If there be any justice in these inductions there must be immense accumulations existing in the Gulf of Mexico, for its area is not above one-third of that from which the sediments have beeen derived.[20] In addition we have the great denudations from the mountainous regions of tropical America and from Mexico.

The land sediments and the lime and silica eliminated from the waters of the sea by organic agencies, and ever being renewed by the decomposition of the rocks through the solvent action of rain-water aided by humic acids, must, together with igneous flows, intrusions and ashes, be building up rock-groups which will eventually form the framework of new land. None the less is this the case when the earth's crust has been long in apparent repose; for there surely will come a critical time when they will begin to react on the earth's interior, so that before being elevated into new land these portions of the earth may go through the volcanic cycle of change. We might in this way travel over the earth's surface and find in every part modified phases of the same actions in progress—for our planet has not yet lost its vitality. All along the west coast of the two Americas volcanic activity is adding to the thickness of the sea-bottom, and the ceaseless denudation of the great mountain ranges provides a covering on a still grander scale. On the Atlantic coast of South America the conditions of the coast are more general, but here a still greater load of sediment is being deposited by the Amazons, La Plata, Orinoco and other great rivers. On the African coast it is the same, and two of the greatest rivers of the world—the Amazons and Congo—pour their tropical floods and the spoils of the land on opposite sides of the Atlantic in the same parallels of latitude.

I have shown that the sediment from 21,000,000 square miles of land, the estimated area of the land draining into the Atlantic, would, at the rate of one foot per 3,000 years, fill up the North and South Atlantic, estimated at 21,000,000 square miles, two miles deep, in 32,000,000 years.[21]

With all this variety I have little doubt that the deposits as a whole will be differentiated from any that have gone before so as to justly enable the time in which they were laid down to be called a Period.

[20] In a valuable paper, entitled, "The Gulf of Mexico as a Measure of Isostacy" (*Ann. Journ. of Science*, vol. xliv., 1892, p. 188), McGee estimates the area of degradation at 1,800,000 square miles, and that of deposition at 100,000 square miles or one eighteenth. This may be true in relation to what is now taking place, but my assumption is that the area of deposition has shifted from one *locus* to another, being conditioned by elevation and subsidence.

[21] "Denudation of the Two Americas," Presidental Address, L'pool. Geol. Soc., 1885.

This will be due mainly to the persistence of the physiographic features of the land-areas, which will only change when the internal forces of the earth, reacting on the sedimentary mantle, develop expansion therein, and by lateral and vertical pressures and movements oftentimes renewed, develop those ridges of the earth called mountain chains, and so diversify the planet's surface by sketching out new land-surfaces where now is sea, thus modifying the form and conditions of the old continents.

General Conclusions.

The result of our reflections upon the group of facts which it has been the object of this paper to bring together in systematic order tends to show that the growth of land-areas of the globe is governed by certain laws of development. The records of the rocks tell us pretty plainly that there must, throughout geologic time, have existed land-areas on the globe comparable in extent with those now existing. It is not my intention to touch upon that vexed question, the permanence of ocean basins, or to sketch out the lines of former land-extensions. We have seen that land-areas grow by accretion from existing land. The ruins of former continents have added to their extent, so that by process of accretion their outlines and physiographic features have altered; therefore, the present continents, though the outgrowth of earlier ones, may be vastly different in form, position and orography from their predecessors. That the land-areas should have been preserved through geologic time, considering that their mean heights are so little above the water, has always presented itself to my mind as a geological crux. We now see that the waste of the land and the collection of the resultant sediments in the bordering seas is Nature's means of renewal, and we further gather that continuity of land-areas throughout geologic time, so necessary for the preservation of terrestrial life, is in this way secured. The origin of mountain ranges and the growth and decay of continents are thus closely related. New lands are the consequents of sedimentary loading and recurrent expansion, acting through a chain of events which I have dealt with in the "Origin of Mountain Ranges," and which seem to me to be the explanation which brings together all the hitherto isolated facts of geology into one comprehensible whole. Our planet's history is not one of fortuitous accident, but of development by law, and, as I believe, in the manner herein of necessity slightly and concisely sketched out.

It is through the labours of many geologists gathering facts out in the field in both hemispheres that we are enabled to approach the subject with any probability of a reasonable solution. As these facts accumulate we shall be in a better position to test, modify, and develop our theory. In the meantime, I have reasonable hopes that this outline may form a not unsuccessful guide in directing future investigators towards a true explanation of the earth's geologic vitality.

T. Mellard Reade.

II.

Wind and Flight.

IT is generally known that all birds turn their heads to the wind when they wish to rise. But the reason of this is not so simple as it is thought to be. If the wind were of perfectly uniform velocity, the bird could gain no assistance from it, and it would make no difference whether he looked down the wind or against it. The moment he left the ground, becoming part of the moving current, he would have, independently of what was gained by his own efforts, no relative velocity. What we feel as a wind might be looked upon as due to the earth revolving within its envelope of air, and this could not possibly affect the bird when once he had left the ground. However strong a breeze may be blowing, people in a balloon will not be conscious of it, unless they look down towards the earth and see the trees and the houses passing rapidly beneath them. If, however, as he rises, the bird is continually entering more rapid currents, then the inertia due to his having just left a stratum where the velocity is less, will cause the wind to act upon him as upon a kite, and assist in lifting him; whereas, if he has no inertia or momentum, he will not rise any more than a kite that has broken its string. It is well to insist upon this point, since even Professor Marey ("Vol des Oiseaux," p. 286) seems to have fallen into the error of supposing that a perfectly uniform breeze can be of assistance to a bird in mounting, if he turns his head towards it.

Mr. R. C. Gilson recently proposed to me to make some experiments in order to discover the rate of increase of velocity with increase of altitude, and to determine, if possible, up to what altitude the increase continues. These experiments were carried out, as far as circumstances allowed, with the assistance of Mr. J. T. Gilson last January. The place chosen was New Romney. There the large extent of flat sands and the absence of trees or cliffs render any irregular diversion of current unlikely. Experiments were first made at low levels with an anemometer. The following figures represent the averages struck from a considerable series of observations. It will be seen that with an occasional exception, due no doubt to the gustiness common to almost all winds, the increase in velocity grows less rapid as the elevation increases.

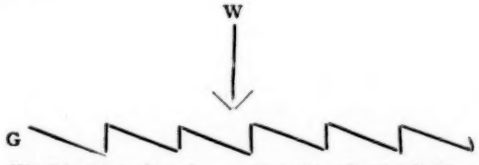
Altitude.	Velocity of wind per minute.	Altitude.	Velocity of wind per minute.
2 inches.	515 feet.	4 ft.	918 feet.
1 ft.	736½ ,,	7 ft. 6 in.	1,021 ,,
2 ft.	770 ,,		

A smaller series of similar experiments carried up to a height of 10 ft. 6 in. showed the same tendency. For greater altitudes the anemometer was to have been run up the string of a kite by means of a second string working through a pulley. But, unfortunately, an accident to the anemometer after a few trials made this method for the time impossible. We then fastened the kite to a spring balance and observed the pull at different heights, using a sextant to discover the exact elevation. Owing to alternating hurricanes and calms all work of the kind was often out of the question, and it is much to be regretted that we had not time to repeat the experiments. They seem to show, however, that there is a steady, though diminishing, increase up to a height of 240 ft. The pull registered at 357 ft. strikes the only false note in the scale, and when that was measured there was a drop in the wind that was perceptible to ourselves.

Altitude.	Pull of Kite.	Altitude.	Pull of Kite.
350 feet.	24 lbs.	126 feet	15–20 lbs.
420 ,,	25 ,,	60 ,,	14–19 ,,
357 ,,	19 ,,	42 ,,	11–20 ,,
204 ,,	18 ,,		

At low levels the jerking of the kite was a difficulty; there is also the question whether the greater length of string carried as the kite mounted higher may not have to some extent modified the results. Probably, however, the error due to the latter course was but slight.

Since making these experiments with a kite, I have tried the plan of letting go a number of small balloons, inflated with hydrogen gas in different degrees and allowing them to race; the larger rising to a height of 500 ft. or more, quite outpaced the lower. But as far as I could judge, small differences of elevation at the higher levels did not much affect the velocity. It would seem that larks in mounting continue to face the wind when they are too high to derive any benefit from it.



W = Direction of wind. G = Line of gull's flight.

While at New Romney I saw two illustrations of the cleverness of birds in turning the comparative slowness of the lower currents to account. Some gulls, wishing to make headway against the blizzard, flew so close to the ground that their wings almost touched it. On

another occasion several were progressing at right angles to the wind, without any apparent movement of their wings, by flying downwards and then making a rapid turn and facing the wind, which, naturally, lifted them as they rose from the slower to the more rapid currents.

The annexed diagram will show this clearly.

At the same place I also made some experiments with a vane working vertically up and down. These were suggested by Lilienthal's book, "Der Vogelflug als Grundlage der Fliegekunst," where he comes to the fantastic conclusion that the normal direction of a wind blowing over a level plain is from 3° to 4° upward. If a vane under these conditions were to point upward, it would be more reasonable to regard the fact as an indication of the eccentricity of all vertical vanes, or of that particular one. My own vane had for its larger arm a piece of thin deal 1 ft. long by 6 in. broad, exactly balanced by a lump of lead attached to the shorter arm. It is true that so small a deviation as 3° to 4° would be hard to detect, but this instrument seemed to indicate that a wind blowing over a level expanse is perfectly horizontal. Experiments on the direction of the wind on, or on either side of, a small barrier, had more interest for me. While standing on a bank only 2 ft. high, its tripod lifting it 4 ft. above the bank, the vane pointed decidedly upward. Five yards to leeward of a bank 8 ft. high, it indicated that the wind blew downward, making a large angle with the horizon; there was but rarely an upward gust. Ten yards from the bank the direction was still mainly downward, but with not infrequent upward movements. At twenty and thirty yards distance the wind came in wild gusts, as often upward as downward. To windward of a bank only rising 5 ft. above the level at a distance of 12 yards, the vane was not quite steady, but, on the whole, horizontal. At six yards there were occasional upward swings; at four yards there was a decided upward tendency, and this though the bank itself presented only a very gentle upward incline.

These results seem to me most important in connection with the soaring of birds. Near a mountain top there must be a perpetual alternation of up and down gusts which a bird can utilise. Happily, there are still hilltops in Great Britain over which the raven and the buzzard can be seen rising in majestic spirals without a motion of the wings. Over a level plain is there any varying velocity available? It is hardly likely that after, say, 400 feet from the ground there is any appreciable increase of velocity with increase of altitude. There is, however, as I have remarked above, an irregularity of another kind even in the steadiest wind. It comes in gusts, and a gyrating adjutant or vulture, long practised in feeling the pulse of the wind, may perhaps make use of this fact, descending when the breeze blows strong, turning when it slackens, and holding himself so that the breeze, when it freshens again, may lift him like a kite.

F. W. HEADLEY.

III.

The Natural History of the Flower.

THE past year was one of some interest in connection with this subject, in that it was the hundredth year since the publication of Christian Conrad Sprengel's book "Das entdeckte Geheimniss der Natur im Bau und in der Befruchtung der Blumen,"—"The Secret of Nature revealed in the Formation and Fertilisation of Flowers." Many papers have been written to celebrate the centenary: we may mention those of Knuth, Kirchner and Potonié, and one by the writer (in this Journal for April, 1893). A facsimile reprint of the classic work has also been published by Mayer and Müller, Berlin (8 marks), and will be found almost indispensable by those who take up this subject. Though it is 100 years since Sprengel started the study of flowers from this point of view, it is only during the last 40 years that any further work has been done, during which time the progress made has been very considerable. Of this work an excellent historical review is contained in the important paper by Macleod (see list), to which we refer later on. It is, unfortunately, in Dutch, but is not difficult to read.

The number of papers published during the last year is not very great, but many are large and some important. We shall deal in the first place with some of the smaller ones. Baroni has described *Rohdea japonica*, showing that it is fertilised by snails, insects, and perhaps worms. Briquet, in his monograph of *Galeopsis*, describes its mechanisms in detail. In *Freycinetia* Burck discovers the first case of a flower visited by bats. The male and female flowers are on separate plants (diœcious), and have large, bright rose-coloured fleshy bracts. These are visited and eaten by a bat (*Pteropus edulis*), which carries the pollen on its head from flower to flower. Miss Keller gives an account of the fertilisation of *Monarda fistulosa*, making the remarkable statement that in this conspicuous flower the anthers open in the bud and discharge some of their pollen upon the stigmas, which also open. The latter close; the flower opens and goes through the usual subsequent history, showing the protandry common in the genus. The same flower has also been described by Robertson and by the writer, who have agreed in looking upon it as well adapted to obtain cross-fertilisation by the agency chiefly of butterflies and large bees. Miss Keller's flowers were examined in November, and the lateness of the season may account for the curious results obtained. Kirchner gives an account of various

plants, usually, but according to him wrongly, supposed to be fertilised by wind alone. These he states to be, to some extent at least, fertilised by insects. Among them are the vine (*Vitis vinifera*), mistletoe (*Viscum album*), *Castanea sativa*, *Chenopodium album*, and others. He also discusses many Umbelliferæ, and gives several examples of protogynous species (that is, having flowers in which the pistil matures before the stamens), chiefly American, in this usually protandrous order (that is, having flowers in which the anthers are ready to shed their pollen before the pistil is ready to receive it). Lagerheim describes insect fertilisation (entomophily) in one of the Cyperaceæ (*Dichromena ciliata*), found near Panama, which possesses colour as an attraction to the insects. Meehan again mentions a number of flowers that appear to be regularly self-fertilised, *e.g.*, Eye-bright (*Euphrasia officinalis*), evening primrose (*Œnothera biennis*), *Cakile americana*, *Trifolium hybridum*, *Malva rotundifolia* (apparently fertilised in the bud), and others. Raunkiaer describes the Danish Cyperaceæ, stating that they are all protogynous, but especially the hermaphrodite ones. Robertson continues his series of papers on flowers and insects in Illinois, describing the mechanisms and insect visitors of various flowers. One paper deals entirely with Umbelliferæ and one with Labiatæ, and reviews of these orders are given, summing up their general features. Scott Elliot describes the visitors of a few British plants, but no points of special interest are brought out. The writer has described several species of *Phacelia*, all showing a method of fertilisation similar to that of *Hydrophyllum*, but some of them adapted for cross-, some for self-fertilisation.

We now turn to the larger papers upon flowers and insects. Several such have appeared, notably by Heinsius, Knuth, Macleod, and Verhœff. Each of these deals fully with a number of plants in some definite locality, and describes the mechanisms and the insect visitors, so that a comparison can be drawn between the various districts. Heinsius describes a number of flowers and their visitors in the Netherlands: 410 visits were noted, 341 on plants also investigated by Müller. In only 140 of these cases were the visitors identical with those noted by Müller; but their general character, as to families, was almost the same. Knuth gives a sketch of the flowers and insects of Capri; only 43 species of the latter were found visiting flowers, while on the mainland there are at least 5,000; the flowers are in consequence sparingly visited and depend mainly upon self-fertilisation, in some cases showing modifications in the floral mechanism calculated to ensure this. The same writer describes the flowers and insects of the North Frisian Islands for comparison with the mainland. Verhœff describes those of Norderney (West Frisian Islands). The results of these writers agree fairly well with one another, and with those of previous workers, and tend to show the relative poorness of the islands in insects and the correlated fact that many flowers usually fertilised by insects have taken more fully to

self-fertilisation, or to vegetative reproduction; the number of wind-fertilised plants, on the other hand, is larger in proportion than on the mainland. Lastly, Macleod publishes the first instalment of a great paper discussing the whole flora of West Flanders. A few new mechanisms are described, as well as many other plants which show some difference in their mechanism and visitors, when compared with the observations made by Müller and others who have studied them in different regions.

The chief interest of recent work upon flowers and their insect visitors seems thus to be in showing the variableness both of the mechanism and of the list of visitors, and the manner in which, when visitors are few, plants become more adapted to self-fertilisation, or take more largely to vegetative reproduction, a point which has been well brought out by Warming in his work upon flowers and insects in Greenland. It is evident from this that it is desirable to study each plant over a great part of its distribution area, and that it will not any longer suffice to say that a plant behaves in a certain way, or exhibits such and such a mechanism, without specifying where and when the observations were made. By careful study of plants in this manner, having regard not merely to their mechanisms for fertilisation in different places, but to the size and other relations of their parts, the profusion or otherwise of vegetative reproduction, the general composition of the flora (which largely determines the competition for insect visits), and other points, we may expect to obtain much valuable information bearing on the problems of geographical botany, of variation, and of evolution. It may here be pointed out that we possess at present scarcely any knowledge of the British flora in this direction. By a careful study of the genus *Medicago* in England, Burkill has observed that, while the mechanism is apparently the same as on the Continent, the visitors of the flower differ, and include a much larger proportion of flies than are observed abroad. The same worker, together with the present writer, has observed various flowers in Wales, and the results (as yet unpublished) support this view of the greater proportion of flies. Now this is just what Lindman and Aurivillius observed in the flora of northern Europe (Norway, Spitzbergen, Nova Zembla, etc.); hence our flora would seem rather more closely allied to these northern floras in this respect than to the nearer continental flora. It is to be hoped that this point may be worked out more fully.

Turning now to work in another direction, it is interesting to note that the experimental study of floral phenomena is making steady progress, and coming more and more into prominence. The most important paper of the year is probably that of Vöchting upon the influence of light upon the formation and development of flowers, especially cleistogamic flowers (those which never open and are necessarily self-fertilised). Plants of various kinds were grown at different distances from the laboratory windows during their flowering

period; the flowers developed under these conditions being carefully measured and compared with the normal type. The first plant described is *Mimulus Tilingii*; here the flowers, developed in poor light, were smaller than the normal, and in the extreme cases did not develop at all, but aborted in the bud stage. An interesting point in the gradual diminution of the corolla was the difference in the rate of decrease of the upper and lower lips. Down to a certain size of flower their proportionate dimensions were nearly constant, but below this the upper lip decreased much more rapidly than the lower. In *Linaria spuria*, a plant which very commonly bears cleistogamic flowers in the wild state, the decrease of illumination resulted in flowers of this type only. Similarly with *Lamium amplexicaule* and other plants. Chickweed (*Stellaria media*). it was found, could be made to produce either ordinary or cleistogamic flowers by suitable illumination. In the wild state it is cleistogamic in bad weather. In *Melandrium album* it was observed that the corolla was the first organ to show a decrease with diminution of the light. From these experiments it follows that, for the normal development of a flower, a certain intensity of light is required; but this varies largely in different species. Low intensity of light results in reduced flowers, the reduction showing first of all in the corolla; in plants with a tendency to cleistogamy, flowers of this kind are produced. Hence we may look upon decrease of light, perhaps, as the primary cause of cleistogamy, calling forth incipient flowers of this type, upon which natural selection may come into play. Vöchting also observed, most markedly in *Mimulus Tilingii*, that the low degree of illumination tended to increase the vegetative activity of the plant. In *Mimulus* the axis of the inflorescence gave rise, instead of flowers, to numerous vegetative shoots. By suitable treatment, the flowers were prevented even from beginning development, and vegetative reproduction alone occurred. Cleistogamy has also been studied by Graebner, who considers that it may be brought about by other agents as well, *e.g.*, by temperature or the weakening action of fungi, etc., or, again, by an unsuitable relation of light to temperature (if one be raised, the other must also be raised, or abnormal floral development will occur). This view is also taken by the present writer, who has studied the behaviour of *Salvia verbenacea* and other plants.

It is thus evident that a study of the natural history of the flower from a physiological standpoint has already led to important results and may be expected to yield many more in the future. The present writer has studied the phenomena bearing on the various distributions of sex by the experimental method during the last four years, drawing therefrom the general conclusion that all these, as well as cleistogamy, are primarily due to the action upon the plant of external causes. Natural Selection apparently only begins to act later on, when the phenomenon in question has been to some extent produced by these causes.

In conclusion may be mentioned some lines on which it seems that profitable work may be done. Experimental investigation into the origin of such phenomena as the various forms of flowers in the same species is much to be desired; also full and thorough study of the flowers and insects of definite districts, especially in the tropics. Our own country remains still to be investigated in this respect. Isolated observations are of little value; the mechanisms of almost all the species of the British flora have been described—on continental plants. We need a thorough study of the whole flora of certain regions, having regard to the composition of the flora, the time of year, the insect visits, the vegetative reproduction of the plants, the exact sizes of their parts, and a comparison of the mechanism with that of the same plant as elsewhere observed. As a model of such work may be taken Macleod's last paper on the flowers of West Flanders. As another line of research, may be suggested the comparison of the same flower as regards size of parts, mechanism, visitors, etc., at different times of year, having careful regard to the weather, in order to obtain an insight into climatal effects upon the parts of the flower, the dichogamy, etc. Those who have access to a botanic garden may also do useful work in observing the mechanisms of exotic flowers, especially those belonging to the many natural orders hitherto untouched, though, owing to the absence of the proper insects, such observations will necessarily be one-sided. In this connection, finally, we may venture to recommend Knuth's short essay, "Ueber blütenbiologische Beobachtungen" (Kiel, 1893: Lipsius and Tischer, 1 mk.), in which is contained a good account of the present state of the flower-theory and the methods of observation in use for this investigation.

OUTLINE BIBLIOGRAPHY.

Arcangeli (Cucurbitaceæ), *Atti congresso botan.*, 1892, Genova.
Baroni (*Rohdea*), *loc. cit.*, and *Nuovo Giorn. Bot. Ital.*, 1893, p. 156.
Briquet (*Galeopsis*), *Mém. couronnes, Acad. roy. Belg.*, 1893.
Burck (*Freycinetia*), *'s Lands plantentuin te Buitenzorg*, Batavia, 1892, p. 67.
Burkill (*Medicago*), *Proc. Camb. Phil. Soc.*, 1894.
Cobelli (Flowers and insects), *Nuov. Giorn. Bot. Ital.*, 1893, p. 6.
De Bonis (*Platanthera*), *Rivista ital. sci. nat. Siena.*, 1893.
Dutailly (*Ceratophyllum*), *Bull. mem. Soc. Linn. Paris*, 1892, p. 1056.
Engler & Prantl's "*Naturlichen Pflanzenfamilien*," contains many papers on floral biology in the numbers for the past year.
Focke (self-sterility), *Abh. naturw. Ver. Bremen*, 1893.
Gander (flowers and insects, self-fertilisation), *Natur. und Offenbarung*, 1893-4.
Gibelli (*Trapa*), *Atti reale Acad. Lincei*, 1893, p. 227.
Giltay (*Brassica*, experiments on crossing and hybridisation), *Bot. Jaarboek*, Gent, 1893, p. 136.
Goebel (water-plants), *Pflanzenbiol. Schilderungen*, Marburg, 1893.
Graebner (cleistogamy), *Verh. Bot. Ver. Brandenburg*, 1893, vol. xxxv., p. 148.

Hansgirg (movements of parts), *Bot. Centralblatt*, 1892-3, and *Berichte deut. Bot. Ges.*, 1890-93.

Heinsius (flowers and insects, Netherlands), *Bot. Jaarboek*, Gent, 1892, p. 54.

Hildebrand (sex variations, etc.), *Bot. Zeit.*, 1892, p. 27, and *Berichte Bot. Ges.*, 1893, p. 476.

Keller (*Monarda*), *Proc. Ac. Nat. Sci. Philadelphia*, 1892, p. 452.

Kerner (general), "*Pflanzenleben*," vol. ii., Leipzig.

Kirchner (plants wrongly supposed anemophilous), *Jahresheft Ver. vater Naturkunde Württemberg*, 1893, p. 96.

——— (Umbelliferæ), *loc. cit.*, 1892, p. 89.

Klebs (influence of light on reproduction), *Biol. Centr.*, 1893, p. 641.

Knuth (plants of Capri), *Bot. Jaarboek*, Gent, 1893, p. 1.

——— (Sprengel), *loc. cit.*, p. 42.

——— (*Primula*), *Bot. Centralblatt* 55, 1893, p. 225.

——— (North Friesian Islands), Kiel, 1893, and other papers.

Lagerheim (*Dichromena*), *Journ. de Bot.*, 1893, p. 181.

Ludwig (various), *Biol. Centralblatt*, 1888-93, and *Mitth. Thuring. Bot. Ver.*, 1892.

Macleod (Flanders flowers), *Bot. Jaarboek*, Gent, 1893, p. 156.

Magocsy-Dietz (*Forsythia*), *Potfusetek a Termeszett. Közlonyhöz*, 1891, p. 121.

Mattei (*Sauromatum*), *Rivista ital. sci. nat. Siena*, 1892, p. 133.

Meehan (various), *Proc. Acad. Nat. Sci. Philadelphia*, 1893, *and Gardeners' Chronicle*, 1892.

Merritt (notes on fertilisation), *Zoe*, 1893, p. 311.

Mesnard (scent), *Comptes Rendus*, 1892, p. 892.

Miyoshi (movements of pollen-tube), *Flora*, 1894, p. 76.

Molisch (ditto), *Sitzb. k. Acad. Wien*, 1893, p. 423.

Newdigate (hermaphrodite hazel), *Journ. of Bot.*, 1893, p. 153.

Newell (*Orchis*, *Æsculus*), *Bot. Gazette*, 1892, p. 165; 1893, p. 107.

Pasquale (*Pentstemon*), *Atti. congr. bot. Genova*, 1892.

Prunet (robbery of honey by bees, etc.), *Revue gén. Bot.*, 1892.

Raunkiær (Cyperaceæ), *Bot. Tidsskrift*, Kjobnhavn, 1893.

Riley (plants and insects), *Proc. Biol. Soc., Washington*, 1892, p. 81.

Robertson (ditto), *Bot. Gazette*, 1893.

Roze (*Naias*, *Ceratophyllum*), *Bull. Soc. Bot. France*, 1893, p. 361.

Scholtz (*Papaver*, *Cobæa*), *Cohn's Beiträge*, 1892-3.

Scott Elliot (British Crucifers), *Trans. Bot. Soc. Edinb.*, vol. xix., 1891-2, p. 237.

Trelease (*Yucca*), *Rept. Missouri Bot. Gdn.*, 1892-3.

Verhœff (flowers and insects on Norderney), *Nova Acta k. Leop. Car. Acad. Naturf.* 61, 1893, p. 49.

Vöchting (influence of light on flowers), *Prings. Jahrb.*, 1893.

Webber (*Yucca*), *Americ. Nat.*, 1892, p. 374.

Wehrli (*Corylus*), *Flora*, Erg. Bd., 1892.

Willis (Gynodiœcism), *Proc. Camb. Phil. Soc.*, 1892 and 1893 (3 papers).

——— (fertilisation), *Journ. Linn. Soc.*, 1893, p. 51.

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IV.

Scorpions and their Geographical Distribution.

IT is a well-established fact that Scorpions have been in existence since the Middle Silurian era. But, unfortunately, almost all that we know of their geological history is furnished by a few specimens from beds of this age, and by a few more discovered in strata of the Coal period. It is also well known that the structural differences between the recent and the carboniferous fossil forms cannot be justifiably regarded in the light of an advance in organisation. In fact, as has already been more than once pointed out, these animals furnish an admirable example of a persistent type of life. From the persistence of structural characters, a persistence of habit may be inferred. At all events, there is little, if any, evidence that these animals, in the past days of their history, have ever gained a livelihood by means other than those employed at the present day. There is no reason for thinking that they have ever adopted an aquatic or arboreal mode of life, or have ever been dependent upon running or leaping powers for the capture of prey or avoidance of enemies; nor is there any foundation for the belief that any species has ever been helped in the struggle for existence by the assumption of any of those disguises of identity that are generally spoken of as protective colouration, or mimicry. That an abundance of time to become specialised into any number of strange forms has been granted them, must be admitted on all hands; but, perhaps, no fact connected with the existing species of Scorpions so forcibly strikes the student as the wonderful closeness of the connection between the different genera that have been established. There is, naturally, a considerable amount of structural variation, if two extremes be selected for comparison; yet the extremes are linked together by such a series of intermediate types that the division of the order into sharply-defined minor groups becomes a task of no small difficulty. Now, this is hardly what we should have looked for in a group of such vast antiquity. We should rather have expected to find the living population of Scorpions composed of a larger, or smaller, number of more or less isolated forms, the annectent types between which would have to be sought for in the records of their past geological history. But, considering that, for obvious reasons, there is practically no record of Scorpion-life between the Carboniferous times and our own day, it is, perhaps, not

surprising that such small links as we require have not yet been found.

The relationship between the fossil and recent Scorpions has been summarised in the classification proposed some few years back by Dr. Thorell. According to this system, these animals are divisible into two great groups—the Apoxypodes, or those with pointed feet, including the Silurian *Palæophonus*, and the Dionychopodes for the Carboniferous Anthracoscorpii and the existing Neoscorpii, all of which have feet terminating in a couple of moveable claws. The chief distinctive feature between the two last-named divisions is the situation of the median eyes in the Anthracoscorpii close to the front border of the carapace, and in front of the lateral eyes. This archaic character, which is very noticeable in the Scorpion's relatives—*Thelyphonus*, *Phrynus*, and *Galeodes*—has not been retained by any existing genus of Scorpions; but, in the absence of evidence to the contrary, it seems justifiable to conclude that those recent forms in which the median ocular tubercle is in the anterior half of the carapace, approach the Anthracoscorpii more nearly than do those in which this tubercle is placed in or behind the middle of this plate. Judged by this test, the Scorpionidæ constitute the most specialised group; for in some of the genera of this family the eyes have moved back far past the middle of the carapace. In the Iuridæ, Buthidæ, Chactidæ, etc., on the contrary, the eyes are in the anterior half of the cephalothoracic shield.

Another test of specialisation seems to be furnished by the form of the sternum of the cephalothorax. In most Scorpions this plate is pentagonal; but in the majority of the Buthidæ it is reduced by lateral compression to a small longitudinally triangular sclerite, and in the Bothriuridæ by antero-posterior compression to a transversely-elongated plate. But that these two forms of the sternum are nothing but specialisations of the pentagonal type is shown by the fact that in the young of all Scorpions the pentagonal shape prevails.

One more apparent criterion of primitiveness may be mentioned. This is the presence in many of the Buthidæ of a spur upon the fifth segment of the last two pairs of limbs, this spur being seemingly homologous with a spur which has been figured by Thorell upon the corresponding segment of the legs in the Silurian *Palæophonus*. Moreover, it is important to note that among the genera of Buthidæ that possess this spur are those that have the sternum of the primitive pentagonal shape.

In the Buthidæ, then, and in no other group of Scorpions, we find genera that still retain the three archaic characters that have been mentioned, namely, the forward position of the median eyes, the pentagonal sternum, and the so-called tibial spurs. We would suggest, too, that the presence of a greater than the normal number of lateral ocelli in some of the Buthidæ may prove to be of interest in this connection. The usual number of these organs is three on each

MAP OF THE WORLD TO ILLUSTRATE THE KNOWN GEOGRAPHICAL DISTRIBUTION OF RECENT SCORPIONS.

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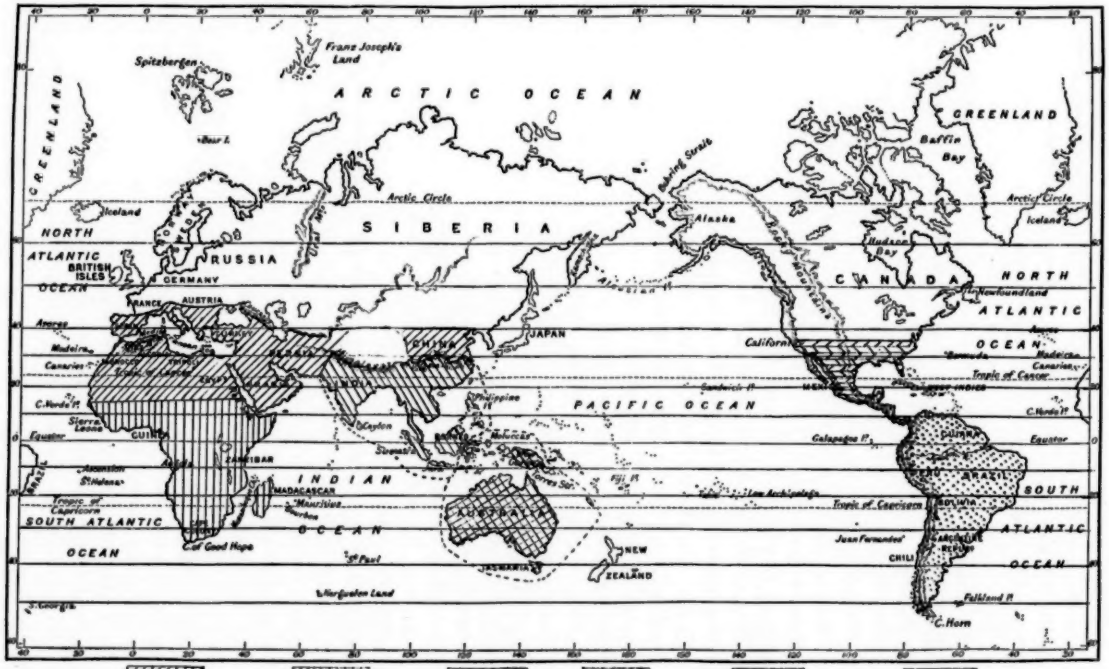

Regions :—Palæarctic. (=Mediterranean.) Ethiopian. Oriental. Australian. Nearctic. (=Sonoran. Neotropical.

side; but in some of the Buthidæ there are as many as five, and the fact that these five may be observed in genera that are not especially related points to the conclusion that the ancestors of this family possessed this number; and this conclusion seems to be borne out by the circumstance that the nearest living ally of the Scorpions, namely, *Thelyphonus*, which we believe to be the most primitive of all the Epectinate Arachnida,[1] may also present five lateral ocelli on each side.

The conclusion that the Buthidæ are, on the whole, the most archaic of living Scorpions is borne out by a study of the geographical distribution of these animals; for, as will be seen in the sequel, this family is represented by peculiar genera in all the quarters of the globe where Scorpions exist.

The absence of proofs of their great antiquity, which was referred to in connection with the inter-relationships of the existing species of Scorpions, is also revealed no less remarkably by a study of their geographical distribution; for in this latter respect they show considerable resemblance to such a relatively recent group as the Mammalia. No doubt our knowledge of the recent species of this latter class is very much more complete than is our knowledge of the Arthropods in question; but so far as we have been able to ascertain, Wallace's map of the Zoological Regions of the world, if we eliminate the northern parts of the so-called Palæarctic and Nearctic Regions where Scorpions do not occur, is closely applicable to this group of animals. We may, therefore, without further words of preface, proceed to discuss the characteristic features of the various regions.

In the Palæarctic Region the northern limit of Scorpions in Europe and Western Asia appears in a general way to be defined by the mountain-chain of which the Pyrenees is the western and the Caucasus the eastern extremity. East of the Caspian they have not been recorded north of the 40th parallel, but they are known to occur at two places upon this line, namely, at Kashgar in Turkestan, and at Pekin in China. The two species from these localities are nearly allied to each other, and they unmistakably belong to the Mediterranean section of the genus *Buthus*. Furthermore, a species of *Buthus*, with distinct Palæarctic affinities, has recently been recorded from Shanghai. Consequently, we must conclude that the Mediterranean fauna extends from Spain and Algeria to the coast of China, with the probable omission of the table-land of Tibet. The southern limit of this area in China is, for want of data, uncertain; but since the Scorpions of Burma, Assam, and North India are totally different from those of Turkestan, Afghanistan, and Persia, we may

[1] Since, as Mr. Laurie has pointed out, the term Ctenophora, which I have recently assigned to the Scorpions as opposed to all other Arachnida which were called Lipoctena, is generally recognised as signifying a group of Cœlenterata, I wish to propose the terms Pectinifera and Epectinata as substitutes for the above.

safely adopt the boundaries that are usually recognised as separating the Palæarctic and Oriental Regions.

The exact limits between the Palæarctic and Ethiopian are also a little uncertain. Mr. Wallace draws the line of demarcation along the tropic of Cancer, and thus refers the northern half of Arabia to the former and the southern to the latter. But, with two exceptions, the Scorpions that occur at Aden, and at other parts of South Arabia, are either identical with Syrian and Egyptian forms, or are very nearly related to them. For instance, *Nebo*, which is met with at Aden and Muscat, is only known elsewhere from Syria and Egypt; *Hemiscorpius* has been obtained at Aden and Baghdad; *Buthus quinque-striatus*, a common Egyptian species, extends to Perim Island and South Arabia, and the Algerian and Egyptian *Prionurus australis* has been received from Muscat. On the other hand, the only Ethiopian types which are found in South Arabia are a species of *Scorpio* and *Parabuthus liosoma*, which ranges from Egypt to Masai-land. Clearly, therefore, the Mediterranean element in South Arabia far surpasses the Ethiopian, and the whole of this country must consequently be looked upon as part of the Palæarctic Region. In Africa it is impossible to draw a hard and fast line until more collecting has been done. We know nothing of the species which presumably inhabit the vast tract lying between Abyssinia on the east and Senegambia and Guinea on the west. On the west coast of the Red Sea, however, the Mediterranean element is represented at Massowah and at Zaila, in Somali-land, by a variety of the Spanish and North African *Buthus europæus*; but species of the essentially Ethiopian genus *Scorpio* extend into Nubia and Abyssinia. A similar partial overlapping of the two faunas occurs on the West Coast of North Africa, namely, in Senegambia, which is the northern limit of *Scorpio*, and the southern limit of *Buthus europæus* and *Prionurus australis*. We may, therefore, draw the line between these two regions along the 15th parallel or thereabouts.

The following is a list of the Palæarctic genera with the known range of each. Those that are peculiar to the region are marked with an asterisk:—**Heterometrus*, two species, North Africa, Syria; **Nebo*, two or three species, Syria, Egypt, and Aden; **Hemiscorpius*, Baghdad, Aden; **Iurus*, one species, Greece, Asia Minor, Egypt; **Belisarius*, one species, Pyrenees; **Euscorpius*, many species, Spain and Algeria to Asia Minor; **Prionurus*, two species, North Africa to Persia and Arabia; *Buthus*, many species, North Africa, South Europe, Persia to Pekin; **Butheolus*, two species, Sicily, Arabia, Persia; *Parabuthus*, one species, Egypt, Arabia.

The Ethiopian Region is very rich in Scorpions, and contains a large number of peculiar genera. It embraces Africa south of the 15th parallel, and Madagascar, the two areas representing distinct sub-regions. The African sub-region is peopled with Scorpionidæ, Ischnuridæ, and Buthidæ. The following is a list of the genera:—

(Scorpionidæ) *Scorpio*, about half a dozen species, Senegambia and the Congo to Abyssinia and Nyassa-land; **Miæphonus*, two species, Caffraria, Damara-land; **Œcopetrus*, two species, Damara-land, Mozambique; **Opisthophthalmus*, many species, Mozambique, Namaqua-land, Cape Colony; (Ischnuridæ) **Ischnurus*, several species, from Angola and Mozambique southwards; **Opisthocentrus*, four or five species, Congo, Transvaal, and Cape Colony; **Chiromachus*, one species, Mozambique; (Buthidæ) **Uroplectes*, several species, Nyassa-land and Cape Colony; **Lepreus*, many species, southwards from the Congo and Somali-land; *Archisometrus*, two species, Congo, Nyassa-land; **Babycurus*, several species, Old Calabar and Angola to Masai-land; *Parabuthus*, several species, Abyssinia, Benguela, Cape Colony; *Buthus*, a few species only, Senegambia and Abyssinia to Caffraria.

At the present time we unfortunately have no intimate knowledge of the Scorpions of Madagascar. Two peculiar genera of Buthidæ, however, namely *Grosphus* and *Tityobuthus*, occur, and two species ascribed to *Babycurus* have been recorded; there is also one peculiar species of *Opisthocentrus* known. The last two are African genera and the first two are essentially African in their affinities. It is, however, highly interesting to note the apparent absence from this continental island of almost all the large African genera of Scorpionidæ and Ischnuridæ. The differences between the genera of Buthidæ inhabiting Africa and Madagascar point to long separation between the two areas; while the absence from Madagascar of the Scorpionidæ seems to indicate that the latter made their way into Africa after the separation had been effected.

The Oriental Region offers some points of resemblance to the African portion of the Ethiopian; but on the whole the two faunas are very distinct. The following genera are known:—(Scorpionidæ) *Scorpio*, several species, India, Ceylon, Java; **Palamnæus*, about four species, Bengal to Borneo and the Philippines; (Ischnuridæ) **Iomachus*, one species, South India; *Hormurus*, one or two species, from Burma eastwards; (Iuridæ) **Scorpiops*, several species, North India, Burma; **Chærilus*, several species, Cashmere and Ceylon to Borneo; (Bothriuridæ) **Timogenes*, one species, Sumatra; (Buthidæ) *Buthus*, one species, India; *Isometrus*, two species, South India, Assam; *Archisometrus*, several species, India, Ceylon, and Burma eastwards; **Charmus* (*Heterocharmus*), three species, Ceylon. The region seems separable into two sub-regions, a western or Indian, containing Ceylon and the greater part of India, and an eastern or Indo-Malayan, extending from Cashmere along the Himalayas to Burma, and thence southwards and eastwards to Borneo and the Philippines. Characteristic of the Indian sub-region is the genus *Scorpio*, which in the Indo-Malayan sub-region has only two representatives, occurring in Sumatra and Java; the single Indian species of *Buthus*, too, does not appear to pass into Burma, while *Iomachus* and *Charmus* are not known from the east side of the Bay of Bengal. In

the Indo-Malayan sub-region the genus *Scorpio* is almost entirely replaced by its near ally, *Palamnæus*, which ranges from Bengal to Borneo and the Philippines. *Hormurus australasiæ* and *Archisometrus mucronatus* have approximately the same range as *Palamnæus*, and are not known from India or Ceylon, while the genera *Scorpiops* and *Chærilus* extend from Cashmere into Assam, Burma, and Tenasserim. Here *Scorpiops*, of which one peculiar species has been recorded from the Deccan, reaches its limit; but *Chærilus*, which is also represented by a peculiar form in Ceylon, passes into Java, Sumatra, and Borneo. These two genera are of special interest, inasmuch as they are allied to the Palæarctic genera *Iurus* and *Euscorpius*, and thus indicate faunistic affinity between the Oriental and Palæarctic regions. A corresponding but rather closer affinity is indicated with the Ethiopian Region by the presence of *Scorpio* in India and Ceylon, and of *Archisometrus* over the whole Oriental Region.

The Australian Region is not easily separable from the Oriental where the two are nearly contiguous. It may be divided into two sub-regions, a northern insular portion or Austro-Malaya, and a southern continental portion or Australia. The following genera are represented:—(Ischnuridæ) *Hormurus*, several species, Celebes, Papua, Solomon Islands, New Caledonia, E. Australia; (Urodacidæ) **Urodacus*, several species, Australia; (Bothriuridæ) *Cercophonius*, one species, Australia; (Buthidæ) *Isometrus*, one species, E. Australia; *Archisometrus*, about three species, Celebes and Flores, Australia; **Isometroides*, two species, Australia. The Australian sub-region is recognisable from the Austro-Malayan by the presence of the genera *Urodacus*, *Cercophonius*, and *Isometroides*, which do not extend into the latter area. This Austro-Malayan sub-region is near akin to the Indo-Malayan. Two species, namely *Archisometrus mucronatus* and *Hormurus australasiæ*, are common to the two; and the characteristically Oriental genus *Chærilus* is represented by a single species in Celebes. But with the exception of *H. australasiæ*, the genus *Hormurus*, of which there is a peculiar species in New Caledonia, does not appear to cross Wallace's Line. There are no indigenous species of Scorpions in New Zealand and none, so far as has been ascertained, in the Pacific Islands.

In North America the northern limit of Scorpions seems to be situated between the 35th and 40th parallels. They thus belong to the Sonoran Province of Merriam. To the west of the Rockies these animals have been recorded from California and Utah; and to the east of this mountain chain they appear to extend into Kansas, Carolina, and Virginia. To the south, that is in Central America, the fauna seems to blend with that of the Neotropical. At all events, we have not sufficient data to enable us to define accurately the limits between the two regions.

Characteristic genera of the Sonoran Province are **Uroctonus* (*Anuroctonus*), three species, California, Utah, Virginia; **Hadrurus*,

one species, Utah, California; **Vejovis*, several species, Carolina, Texas, and Utah; and *Centrurus*, two or three species, from Georgia, Florida, Texas, Kansas, and California. Of these *Uroctonus* does not appear to pass into Mexico; but *Hadrurus hirsutus* extends certainly as far as Jalapa, while *Vejovis* is represented by many species in various parts of Mexico, but does not, so far as is known to me, spread into Nicaragua or Costa Rica. Consequently, we must conclude that the greater part of Mexico belongs to the Sonoran Province. The genus *Centrurus*, which inhabits the southern States, seems to form part of the Neotropical fauna; for it is represented by several species inhabiting Central America, the West Indies, Colombia, etc. Similarly, *Diplocentrus* is common to the two regions, since it occurs in Texas, Mexico, the West Indies, and Brazil. But with these exceptions the Neotropical fauna of America, including Panama and all the countries to the south of it, as well as the West Indies, is very distinct from that of all other countries. The following genera are found:—(Diplocentridæ) *Diplocentrus*, two or three species, West Indies, Brazil; (Ischnuridæ) **Opisthacanthus* one species, Panama, Colombia; (Iuridæ) **Hadruroides*, four or five species, West Indies, Peru, Bolivia; **Caraboctonus*, one species, Chili, Brazil; (Chactidæ) **Broteas*, four species, Guiana, Brazil, La Plata; **Megacormus*, one species, Mexico; **Broteochactas*, three species, Guiana, Venezuela, Colombia; **Hadrurochactas*, one species, British Guiana; **Teuthraustes* two species, Eucador; **Chactas* and **Heterochactas*, about twelve species, Venezuela, Colombia, Ecuador, Peru; (Bothriuridæ) **Bothriurus*, six or eight species, Peru, Chili, Uruguay, South Brazil; **Brachistosternus*, three or four species, Peru, Chili, Argentine; **Mecocentrus*, one species, Brazil; **Phoniocercus*, one species, Brazil; **Thestylus*, one species, Brazil; **Centromachus*, one species, Chili; **Urophonius*, two species, Chili, Argentine, Uruguay; (Buthidæ) *Centrurus*, many species, West Indies, Colombia, Chili; **Heteroctenus*, two species, Hayti, Mexico, Brazil; **Tityus*, many species, Mexico, West Indies, Colombia, Brazil, Argentine; **Ananteris*, one species, Brazil.

These data show how very specialised is the Neotropical fauna. The Chactidæ are confined to the region, and, with the possible exception of *Cercophonius*, none of the Neotropical genera of Bothriuridæ are found elsewhere. Moreover, three out of the four genera of Buthidæ are peculiar; so, too, is the single genus of Ischnuridæ, while the remaining genus of Buthidæ occurs elsewhere only in the Sonoran Province of North America.

Nothing is known of the Scorpions of Patagonia. Darwin, however, tells us that they are found at least as far to the south as the 47th parallel. It is, of course, highly probable that the species of this country will prove to be nearly related to those of the Argentine Republic.

At present our limited knowledge makes it hardly possible to

divide the Neotropical Region into sub-regions. In a general way, however, the northern parts of the area seem to be characterised by the presence of Chactidæ, and the southern by the presence of Bothriuridæ; and it is interesting to note that both of these groups are absent from the West Indies. There are, too, some further points of interest connected with these islands. For instance, the species known from the larger islands—*i.e.*, Cuba, Jamaica, Hayti, and Porto Rico—are, for the most part, also found on the mainland of Central or South America; while the species that have been obtained in the smaller islands to the south-east—*e.g.*, Montserrat, St. Lucia, St. Vincent, and Grenada—are peculiar forms of the Central and South American genera *Tityus* and *Diplocentrus*.

Some of the facts connected with the distribution of Scorpions set forth in the preceding paragraphs offer interesting points for further discussion.

It is to be observed, in the first place, that arms of the sea constitute barriers which these animals cannot pass; yet, although their means of dispersal are very limited, the antiquity of the group is so great that it has succeeded in distributing itself over all the contiguous land areas of the globe. In fact, as we have seen, these animals have been met with in all parts of the continents which have been explored, with the exception of the colder parts of the Northern Hemisphere, and in all continental islands with the single exception of New Zealand. But we know that in pre-Glacial Tertiary times they extended in Europe as far to the north as what is now the southern shore of the Baltic; and there cannot be much doubt, one would think, that their absence at the present day from all that area of the Northern Hemisphere which lies north of the 45th parallel of latitude is to be attributed to the recent glaciation of this part of the world.

But their absence from New Zealand is not to be so easily explained away. It is clear, however, that we have to account for the fact upon one of two hypotheses, namely, that they have never succeeded in reaching the country in question, or that they have been exterminated since arriving there.

The first hypothesis, however, seems hardly likely to be the true one, if there has ever been an uninterrupted and long-continued land-connection between New Zealand and the south-eastern parts of Asia by way of Australia or Austro-Malaya. But if, on the other hand, the connecting land was composed merely of islands, the intervening seas would probably have afforded an effectual barrier to their migration.

With regard to the hypothesis of extermination, it may be said that, so far as is known, there is nothing in the physical conditions of New Zealand antagonistic to Scorpion life, and it must be left to the

geologists to decide whether there is any evidence in favour of the glaciation of this country which would account for the extermination of Scorpions, supposing they had ever succeeded in establishing themselves there. For myself, I am disposed to think that none of the recent groups of Scorpions have ever been represented in New Zealand; in which case it seems certain that the existing Scorpion population of Australia made its way, like the Mammalia, into the latter country after the isolation of New Zealand.

So, too, with Madagascar. The absence of nearly all the large Ethiopian forms from this island shows that the severance from the mainland took place before the typical African genera had appeared in the country. And the presence in Madagascar of genera of Buthidæ and Ischnuridæ, peculiar but with marked African affinities, points to the conclusion that, at the time of the connection with Africa, species of these two families were the principal if not the sole representatives of Scorpions in the Ethiopian Region.

A discussion of the fauna of Madagascar naturally leads us to inquire whether a study of the distribution of Scorpions affords any support to the hypothesis of a former direct connection between this island and the Oriental Region. But since there is no similarity between the species of the two areas, we may dismiss the subject by saying that the Scorpions do not furnish a particle of evidence that the union has ever been more complete than it is at present.

The absence of evidence in favour of Lemuria obviously suggests an examination of the question of the existence of Antarctica, to which many other groups bear witness. But here again all the evidence is on the negative side. For, firstly, there is the absence of Scorpions from New Zealand; secondly, total dissimilarity between the Scorpions of Madagascar and Australia, and of South Africa and South America; and, lastly, the almost complete want of resemblance between the Scorpions of Australia and those of South America. The one point of resemblance between these two countries is the presence in Australia of a genus of the Bothriuridæ, a family which is almost exclusively confined to the Neotropical area. This case has been cited by Mr. Forbes, in his interesting paper on the Chatham Islands, as an item of evidence in favour of Antarctica. But, since furnishing Mr. Forbes with the information that the Australian *Cercophonius squama* occurs also in Chili, I have found grounds for doubting the truth of the evidence upon which the information was based. If, however, it is so, the fact of its being the *same* species that occurs on these two shores of the South Pacific favours the view of artificial or fortuitous introduction; for apart from this one there is not a single species or even genus which is common to the Old and New Worlds. But whether or not the genus *Cercophonius* occurs in Australia and South America, we still have to account for the presence in the former country of a Scorpion belonging to a family which is typically South American. It is possible, of course, that this may be explained, as Mr. Forbes

supposed, on the hypothesis of a southern land-connection between the two countries. But this is not the only theory that will account for the circumstance ; for it is possible that the family to which the genera belong had once a wide extension in the Northern Hemisphere, and that although exterminated, for the most part, in the keener competition of more northern areas, some of the genera, like the Marsupial Mammals, have found places of refuge in the countries to which they are now restricted; and this supposition is borne out by the fact that a solitary representative of the family has been recently discovered in Sumatra.

It is necessary to bear in mind that the general absence of similarity between the Scorpions of the three southern extensions of land is not of the same value in disproving the former existence of Antarctica as is the absence of similarity between Madagascar and the Oriental Region in disproving the existence of Lemuria; for while it is clear that the Scorpions could have freely migrated across a land lying in the centre of the tropical Indian Ocean, it is equally clear that, unless there was a long-continued genial climate in the Antarctic Seas, they could never have succeeded in making their way even along the northern coast-line of the southern continent that Mr. Forbes has delineated.

A further modification of Sclater and Wallace's Zoö-geographical Map that has been suggested, and often adopted, is the union of the so-called Nearctic and Palæarctic into one region, for which the term Holarctic has been proposed; but a study of the distribution of Scorpions affords no support to this change, inasmuch as it shows that none of the genera extend from one region to the other, and even when the families are taken into consideration, it is found that the similarity between the Palæarctic and Nearctic is no greater than that between the Palæarctic and Oriental.

There still remain one or two apparent anomalies in the distribution of some of the families of Scorpions to be accounted for. The first and strangest of these, furnished by the Ischnuridæ, is the unquestionably close relationship that exists between the exclusively South African genus *Opisthocentrus* and the genus *Opisthacanthus*, which is restricted to Panama, Colombia, etc. A somewhat similar peculiarity is found in the case of the two known genera of the Diplocentridæ, namely, *Diplocentrus*, which is found in the Antilles and Central America, and *Nebo*, which occurs in Arabia, Egypt, and Syria. Again, coming further to the north, we find that in the Iuridæ the Levantine genus *Iurus* has one of its nearest allies in the Californian *Uroctonus*, and that the Neotropical group of the Chactidæ has a South European representative in *Euscorpius*.

These four cases, taken together, seem to me to point to the conclusion that, at one period, these families had a widely-extended range in the Northern Hemisphere, and were enabled thereby to pass from Eastern Asia into Western North America. And the one item of

information we possess regarding comparatively recent fossil Scorpions is corroborative of this supposition. I refer to the case of a Scorpion described as a *Tityus* from the amber beds of the Baltic. From this we learn that, in pre-Miocene Tertiary times, Scorpions in Europe reached as far to the north as the 55th parallel, that is, to about the same latitude as the chain of islands which now connects Kamschatka with Alaska. Moreover, although the generic determination of this Scorpion cannot be unreservedly accepted, yet it is highly important to note that, at the present day, in the Old World the only Scorpions which could reasonably be identified as *Tityus* are found to the south of the tropic of Cancer. It seems, therefore, legitimate to conclude that in pre-Glacial Tertiary times the ancestors of our existing Old World tropical Scorpion fauna extended far enough to the north in the Europæo-Asiatic continent to pass freely along any land-connection with North America. But the advent of glacial conditions in later Tertiary times, and the consequent extermination of the Scorpions in the northern parts of the Northern Hemisphere, would soon put an end to the intercourse between the Asiatic and North American species; and these, under the changed conditions, might have become differentiated into the distinct types which inhabit these countries at the present day.

This supposition, then, of the former wide distribution in the Northern Hemisphere of the ancestors of the Ischnuridæ and other tropical or sub-tropical families, furnishes, it seems to me, the most satisfactory explanation of the resemblances and differences that are observable between the Scorpions of the Old and New Worlds. Moreover, the restriction of the Diplocentridæ and Ischnuridæ at the present time in South America to the northern parts of this region points to relatively recent immigration of these groups from North America. In fact, it seems probable that they made their way into the country at a time when it was occupied by ancestors of the existing Neotropical Bothriuridæ and Buthidæ; and this last conclusion points to the further one that these latter two families belong to an older type than the two before-mentioned groups, which are nearly related to the Scorpionidæ. This hypothesis, too, is borne out by the confinement of the Bothriuridæ in the Eastern Hemisphere to Sumatra and Australia, and by the fact that, although the Buthidæ are cosmopolitan in their range, yet peculiar genera of the family are found in South Africa, Madagascar, Ceylon, Australia, and South America.

R. I. POCOCK.

V.

Further Notes upon Habits of Insects.

IN a former review contributed to NATURAL SCIENCE (vol. iii., p. 267), I referred to Herr Verhoeff's researches into the habits of the social and solitary wasps and bees. This interesting subject has lately received further attention from a French observer, M. Paul Marchal, who (1, 2) gives details of the habits of two genera of the digging or fossorial wasps—*Bembex* and *Crabro*. He observed *Bembex rostrata* on coast sand-hills, and watched the operations of digging the nest and catching the prey to serve as food for the grubs. The prey of *Bembex* consists of species of *Eristalis*—large two-winged hovering-flies. M. Marchal collected a stock of these insects and, having attached the end of a silk thread to a leg of each, conveyed them to the haunts of the *Bembex*, where he let one fly, retaining the other end of the thread. The *Bembex* seized the *Eristalis* with great rapidity, held the fly back downwards beneath her body and pierced it with her sting. On releasing the fly from its captor, it was found to be quite motionless, except for feeble movements of the jaws and abdominal viscera, and in a few days it was dead and began to dry up. Fabre established the fact that *Bembex* brings a fresh fly each day to her progeny; hence there is no necessity that the life of the victim should be prolonged, as in the case of the prey of many sand-wasps.

On some occasions M. Marchal was surprised to find the *Bembices* engaged in furious and apparently aimless digging, giving the observer "l'impression d'être de véritables maniaques." His captive flies were neglected, or one put directly in front of the *Bembex* only caused the wasp to move away a few inches and recommence her strange pastime. This is clearly an aberration of the instinct of nest-making, and M. Marchal suggests that it may overcome the insect when, by reason of a high wind or otherwise, she is prevented from hunting.

Crabro cephalotes was observed to make her nest in an old felled walnut tree, by forming a tunnel curved like an irregular **3**, from which proceeded branches, some of them forked: at the end of these were the cells where the eggs were laid and the grubs hatched. Each cell was sealed with a plug of sawdust filling up its branch of the tunnel, after the wasp had placed in it from six to ten paralysed flies —mostly *Syrphi*. In carrying these into the nest, she was observed

to walk on five or four legs, holding the prey beneath her by one or both legs of the intermediate pair. All her maternal care did not ensure the safety of her offspring from the attacks of a large ichneumon fly, *Ephialtes albicinctus*, which was found in the tunnel, and whose grub and pupa were found in the cocoons of the *Crabro*. The pupa (the limbs of which are, as is usual in hymenoptera, free) can turn itself over when disturbed.

In the paper in NATURAL SCIENCE already mentioned, I also referred to Dr. Sharp's researches upon stridulation in ants. M. Ch. Janet has (3) been working at the same subject, but, like the former observers mentioned by Dr. Sharp, he does not distinguish between the true stridulating organs and the ordinary sculpture of the segments. He mentions that a number of red ants (*Myrmica*) imprisoned between two pieces of glass fixed by cement, made a noise like the gentle boiling of water in a closed vessel, when their prison was held to the ear. The noise was specially audible when the ants were irritated by the observer blowing between the two pieces of glass.

In NATURAL SCIENCE for November last (vol. iii., p. 353), Mr. Rothera gave us an interesting paper on gall-producing insects, in which he brought forward arguments against the view that the formation of a gall is due to poison deposited with the egg in the plant by the parent insect. Dr. F. Heim, however, in a recent memoir (4), defends this view. His observations were not made upon any of the gall-flies (Cynipidæ), but upon a species of saw-fly (*Nematus salicis*, Jur.[1]), whose grubs pass their early stage within galls produced upon the leaves of willows. The female fly appears in May and makes a triangular cut close to one of the veins of the leaf; in this the eggs and poison are laid, and the gall is formed before the grub is hatched. It is evident, therefore, that the malformation cannot be due to any mechanical irritation by the larva, but from Mr. Rothera's article it appears that in such a case he would attribute it to some chemical irritant in the egg. The gall takes three or four weeks to attain its full size, by which time it appears as an ellipsoidal swelling, 1 cm. long, 5 mm. wide, and 5 mm. thick, of a paler green than the normal hue of the leaf, and with a somewhat purplish tint. Transverse sections showed the gall to have an epidermis with thickened cuticle, almost destitute of stomata; beneath this were cells containing a red colouring matter, shown by chemical tests to be a derivative of tannin, like the pigments found in fruits; the internal layer consisted of small cells, very rich in chlorophyll. The grub, when hatched, is of the usual saw-fly type and colourless, but becomes greenish by feeding. It undergoes no moult within the gall. After two or three weeks it makes a round opening in its habitation, by

[1] This insect is not *Nematus salicis*, L., whose grubs do not live in galls, but spend all their lives free on the leaves. I have not been able to trace the synonymy.

which, a few days later, it emerges, and passes the rest of its life, which lasts several weeks more, feeding freely upon the leaves of the tree. This is an observation of much interest, giving us a link between the habits of grubs like those of *N. salicis*, L., which feed openly all their lives, and those like *N. salicis-cinereæ* and *N. gallicola*, which do not come out of their galls till nearly ready to pupate. The pupal stage of the present species is passed in a cocoon buried in the ground. The brood of flies, consisting entirely of females, appears in August, and a parthenogenetic egg-laying ensues. The grubs of this second generation pass through a similar experience to those of the summer brood, and are full-fed by the time the leaves of their food-tree are ready to fall. The winter is passed by the insects underground as pupæ, and among the flies produced from these in the following spring a few males are found. Thus, as in so many other cases among insects, sexual and virgin reproduction alternate.

Dr. Heim concludes his memoir with some general considerations on galls, in which, as already mentioned, he defends the view that those structures are due to the action of poison injected by the parent insect. He compares the dense parenchyma of the gall of *Nematus* with the cell-proliferation which occurs in cancerous tissues in man, criticises M. Beyerinck's comparison of the structure of galls to that of shoots, and calls attention to the analogy between galls and fruits, suggesting that the action of the insect-poison on the leaf-tissues is comparable to that of a secretion of the pollen-tube upon the carpels of a fertilised flower.

Though the hymenoptera surpass all other insects in the interest of their habits, much is to be learnt from the other orders. Dr. A. Seitz has recently (5) collected a large number of noteworthy facts regarding the butterflies and moths, with special reference to their feeding in the larval and perfect stages. The first meal of a young caterpillar is well-known to be often its empty egg-shell; from this it turns to feed upon the leaves whereon its provident parent had laid her eggs. But in a few cases hatching takes place in winter or early spring, and the young larvæ have then to find a temporary food until their own special plant is available. For example, the caterpillars of some species of *Xanthia* and other noctuid moths feed at first upon willow-catkins. All who have tried to rear caterpillars know that, while those of some species will feed only on one particular species of plant, others will eat several species of the same genus or family, while others again are still less particular, some being able to feed on almost any green herb. That caterpillars, in this respect, have often very nice tastes there can be no doubt, and Dr. Seitz suggests further that the jaws of certain species are unable to bite leaves of different textures. It is curious to note how certain species change their food in different localities, a caterpillar confined to one plant in one place being less particular elsewhere. Individual aberrations in food are of special interest, in suggesting the starting

point for a change in the race. When we consider the vast numbers of the lepidoptera, and the structural modifications which they have undergone, their generally faithful adherence to a vegetable diet (mostly leaves, rarely wood) is remarkable. The clothes-moths (Tineids) have invaded our dwellings and found a congenial food-stuff for their larvæ in our garments. A few small species of the same group (*Ephestia*) are reared in meal and other human food-stores, while the caterpillars of some pyralid moths (*Asopia*, *Aglossa*) feed upon kitchen refuse. Two species of crambid moths (*Aphomia sociella* and *Galleria melonella*) find a home in bee-hives, where their caterpillars feed upon the wax, while the waxy secretion from the body of the great American lantern-fly (*Fulgora candelaria*) serves both as shelter and food for the caterpillar of the moth *Epipyrops anomala*. Very few caterpillars have developed a thoroughly carnivorous habit. *Cosmia trapezina* feeds on oak and other leaves, but devours smaller caterpillars which happen to get in its way, and if shaken from the tree, eats other larvæ while climbing the trunk. *Xylina ornithopus* and a few other species are said to be always carnivorous when opportunity offers; the small looping caterpillar of a "pug"-moth (*Eupithecia coronata*) has been observed to eat a larva three times as big as itself. The caterpillars of *Orthosia pistacina* live together in peace while their food is moist, but devour each other when it dries up; this is true cannibalism—a term which should not be applied to the habit of preying on another species. Dr. Seitz remarks that in vertebrate animals also, thirst is more maddening than hunger. Cannibalism has been observed in a few other cases. Patagonia yields several examples of carnivorous caterpillars, as might be expected from the poverty of its flora. A few carnivorous caterpillars do not attack other caterpillars, but prey upon insects of different kinds; among these *Fenescia tarquinius*, which eats aphides, and *Erastria scitula*, which feeds upon scale insects, must be reckoned as benefactors to mankind.

The life-history of the latter moth has lately been worked out in detail by Dr. H. Rouzaud, and is described (6) by Professor V. Riley. It inhabits the shores of the Mediterranean, and its caterpillar devours the coccids upon various fruit-trees, specially the black-scale (*Lecanium oleæ*) of the olive. The moth, which is a small noctuid, the white markings on whose wings give it the appearance of a bird-dropping when at rest in the daytime, appears in May, and lays her eggs, singly and far apart, upon the trees infested by the coccids. When hatched, the young caterpillar selects a large female coccid, eats its way through the scale, and devours the insect beneath; having done this it makes its way to a fresh victim. As it increases in size it forms a case for itself made of the scales of its victims, excrement, etc., bound together by silk which it spins, and, protected by this covering, which closely resembles the smut-covered bark of the tree, it roams about during its later stages, devouring several

coccids every day. The caterpillar is short and stumpy in shape, tapering towards the head, and recalling in appearance the maggots of some flies. Only the three hinder pairs of pro-legs are functional; those on the fifth and sixth abdominal segments are used for walking, the hindmost pair being attached to the case, which they keep in position. When full-fed, the caterpillar chooses a crevice in the bark or a fork between two branches, where it fixes its case, spins a cocoon, and pupates, having first taken the precaution to gnaw an aperture through which the moth can come out. So rapid is the transformation, that four or five broods follow each other during the summer. The execution upon the coccids must, therefore, be very great, and Professor Riley states that it is intended to import the moth into California, where it is hoped that it may prove as serviceable as the other predatory insects which have been introduced there to make war upon the destroyers of the fruit-trees.

After discussing carnivorous caterpillars, Dr. Seitz gives instances of the habit of nest-making which some caterpillars practise, living in colonies, with the web spun by their united labour as a protection. The influence of the food of the larva upon the colour and size of the imago is next considered. Some observers have thought that the sex of the moth is affected by the food of the caterpillar, poverty of nutriment producing males; but Dr. Seitz points out that the fact on which this rests—that some neglected larvæ of a batch pupating early produced males, and the rest, fed afterwards, females—is better explained by supposing a tendency to an earlier development of males, or proterandry (if a botanical term may be borrowed). There can be little doubt that the sex is irrevocably fixed in the egg. The difference of feeding by which bees can rear a worker or a queen at will is not, of course, an instance of determination of sex by food, as the worker is only an infertile female.

Dr. Seitz discusses also the causes which govern the time of development of a species, pointing out the advantage of rapid growth, when climatic conditions permit, in giving rise to several broods, and thus enormously increasing the number of individuals. The relation between caterpillar and imago, as regards size, is of considerable interest, the body of the latter being in some cases much smaller than that of the former, while in others the difference is less marked. In some moths we find a complete division of labour between the larval and perfect stages, the former being entirely devoted to feeding, the latter to reproduction. In such the mouth-organs of the moth, which lives but a few days, are vestigial. Dr. Seitz suggests that, as this condition exists in some of the most primitive families (Cossidæ, Hepialidæ), these may have come down to us unchanged from a period anterior to that of honey-bearing flowers. In some of the highest moth-families, however (Saturniidæ, Arctiidæ), we find the same state of things, and it seems more likely that in all cases it is a degradation and not a survival. A review of the habits of the butter-

flies and moths which do feed concludes Dr. Seitz's paper. He mentions various observations of these insects drinking water, or dew from leaves, and gives a list of the very unsavoury substances for which they sometimes forsake their normal food—honey. Blood from the wound of an animal is one of these not generally known. The advantages taken by collectors of such aberrant tastes are sufficiently familiar; it is sad to remember that gorgeous butterflies can be lured to capture by a bait of putrid meat, and moths by a mixture of treacle and intoxicating drink.

REFERENCES.

1. **Marchal, P.**—"Remarques sur les *Bembex*." *Ann. Soc. Ent. France*, vol. lxii., 1893, pp. 93–98.

2. ————.—"Observations biologiques sur les Crabronides," *t.c.*, pp. 331–338, pl. 8.

3. **Janet, C.**—"Note sur la production des sons chez les Fourmis, et sur les organes qui les produisent," *t.c.*, pp. 159–168.

4. **Heim, F.**—"Observations sur les galles produites sur *Salix babylonica* par *Nematus salicis*, suivies de quelques réflexions sur l'importance des phénomènes de cécidiogénèse pour la biologie générale," *t.c.*, pp. 347–372.

5. **Seitz, A.**—"Allgemeine Biologie der Schmetterlinge. II. Die Ernährung." *Zool. Jahrb.* (*Abth. für Syst. U.S.W.*), vol. vii., 1893, pp. 131–166.

6. **Riley, C. V.**—"An important predatory insect (*Erastria scitula*, Ramb.)." *Insect Life*, vol. vi., 1893-4, pp. 7–10.

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SOME NEW BOOKS.

Mr. Bateson on Variation.

Materials for the Study of Variation, Treated with Especial Regard to Discontinuity in the Origin of Species. By William Bateson, M.A., Fellow of St. John's College, Cambridge. London: Macmillan & Co., 1894. Price 21s. nett.

Those who have been following the progress of the science of morphology in recent years must have noticed a change in its attitude and methods, a change to which Natural Science has repeatedly called attention. The details of Comparative Anatomy and Embryology are being investigated with continued enthusiasm, but there is a chastened spirit in the matter of basing huge generalisations upon particular facts. In the study of the cell and nucleus, and of the physical nature of protoplasm, results so novel and so interesting are being obtained, that no doubt we over-estimate greatly their theoretical importance. But the other results of microscopy certainly we do not exaggerate. The centre of gravity of morphological investigation is changing. Many are working at what Professor Lankester aptly called Bionomics, the study of organisms as they actually live; others are making experimental enquiries in teratology, in cross-breeding, on the ovum and spermatozoon, and Mr. Bateson, Professor Weldon, and others are studying variation in new ways. All these are matters which, in the first enthusiasm for studying anatomy and embryology in the new light of Darwinism, morphologists considered questions for the curious rather than for the scientific. But as Mr. Bateson insists in his preface, the problem of species has not been solved by anatomy and embryology, and we must turn to new ways for new lights. In discussing Mr. Bateson's book, I shall endeavour rather to give an account of it than to present in detail many objections to his method of argument. For whether or no it is on Mr. Bateson's lines that the problem of species will find solution, undoubtedly his ingenious and careful work should serve to stimulate many to a side of biological inquiry too long neglected. Let me, then, endeavour to present the main lines of his argument. The salient feature of life is that the forms of living things are diverse. Those who study groups may differ as to which characters are specific, but the naturalist and the man in the street are agreed that species are different kinds of animals not to be confounded. Species are what Mr. Bateson calls "discontinuous" in the main, although occasionally linking forms and doubtful cases occur. Next, it is obvious that specific forms fit, on the whole, the places in which they have to live. The third simple fact is that in the succession from parent to offspring variation occurs. Mr. Bateson assumes the doctrine of descent, or, as he puts it, that the specific differences between species and species have come about through, and are compounded of, the individual differences between parent and offspring. He assumes it because there is a balance of evidence in its favour,

and because if it is not true we can get no further with the problem. According to Lamarck's solution of the problem of species, organisms make an appropriate structural and physiological response to the environment, and by the inheritance and accumulation of these, species arise. According to Darwin, in the struggle for existence, those of occurring variations which are in the direction of adaptation survive, the others do not. Cases of adaptation, as Lamarck understood it, are, says Mr. Bateson, significantly few, while Natural Selection is a true cause.

On the other hand, upon both theories specific diversity of form is dependent on diversity of environment, and apparently identical species live in most different environments, while apparently closely-allied but distinct species live under apparently identical conditions. In this Mr. Bateson sees an ultimate difficulty, insoluble by previously-existing facts and methods. His new method is to study variation. Mr. Bateson then dismisses the Recapitulation Theory as corroborating only the general theory of descent, and as inapplicable to the history of individual cases. He dismisses also the study of adaptation until such time as there be with it exact information about the actual amount of preservation caused by particular adaptations. He lays great stress on the familiar difficulty of accounting by Natural Selection for the incipient stages of adaptation, and finally suggests that a study of variation may reveal that the discontinuity of species arises from a discontinuity of variation. As he regards discontinuity in species as the chief difficulty, he proposes for the present to consider evidence only of discontinuity in variation. Next, Mr. Bateson proposes to consider chiefly variation with regard to symmetry. In almost every living thing pattern and symmetry are a striking feature, so much so that, if we understood pattern and symmetry, we should not be far from understanding organism. A great part of symmetry depends on repetition of parts, and for this Mr. Bateson employs the new term *merism*. Numerical and geometrical variation is of frequent occurrence. Mr. Bateson calls it meristic, and the evidence in this book deals almost entirely with it. It is of importance, first because differences in number and symmetry are frequently specific differences between organisms, and, therefore, because meristic change has occurred in evolution. It is found that meristic variation is very often discontinuous, in some cases of repetition always so. This, of course, suggests that the magnitude of the integral steps by which variation proceeds is often greater than most have supposed. *Substantive* variation, or variation in the actual quality of the elements of an organic structure, is in most cases to be distinguished carefully from *meristic* variation, although the two may occur in conjunction.

He sees in merism a general law of the organic world, and therefore dismisses all attempts to make metameric repetition an indication of community of descent—as, for instance, in seeking segmented invertebrates as the necessary ancestors of segmented vertebrates. Still more he repudiates the attempt to assign individual values to the members of a meristic series, as, for instance, the attempt to definitely compare and homologise the nerves in all the groups of vertebrates.

He draws an analogy between asexual reproduction and the production of a meristic series, and suggests that variation among the members of a meristic series may occur just as variation, although comparatively rarely, may occur among asexually-produced individuals. Similarly, he compares the relations between a paired metameric series to the relations between the first two segmentation spheres of an ovum, separation of which, as Driesch and E. B. Wilson

have shown, causes, when complete, two individuals, when incomplete, a double monster.

To make plain what he means by discontinuity in variation, Mr. Bateson gives a number of instances of discontinuity in substantive variation. In the case of 583 mature male earwigs collected at the same time, in the same locality, it was found that the length of the forceps varied from two and a half to nine millimetres. In the most common cases of variation of this kind, it is found that, when a curve is drawn of which the ordinates represent the numbers of individuals, and the abscissæ the lengths, that the curve is a simple one, corresponding to what is called a curve of error. In other words, individuals with a mean length are the most common, individuals with extreme lengths, above and below the average, are most rare. In Mr. Bateson's earwigs there were two curves of error, two common kinds of earwigs. About 120 had a length of three and a half mm., about 90 of seven mm., and the numbers tapered off to the extremes and to the mean.

Sudden variations of colour are very common, and as these are generally from one colour directly to another colour without intermediate shades, it is clear that colour-variation may be discontinuous. Other common discontinuous variations are hairless mice or rats, bull-dog headed fish, and so forth. As typical examples of what he means by discontinuity in meristic variation, Mr. Bateson takes two cases. The first is where a flower—for instance a tulip—has all the parts in multiples of four, instead of in multiples of three. The change is complete, the division into four and the resulting symmetry is as perfect as the normal division into three. The second case is that of the tarsus of the leg of a blackbeetle. Usually this consists of five joints, but as a common variation the tarsus of one side may consist only of four. But in this case, as in the tulip, the new symmetry is complete. The four-jointed tarsus is of the usual length, and it is as perfectly shaped, and apparently as workmanlike a production, as the normal form. These two cases show what Mr. Bateson's extended observations clearly establish. Variations so massive as to be clearly discontinuous with the normal form, show for the most part no trace of monstrosity or irregularity, but are so clearly co-ordinated to their function, and to the general symmetry of the body, that only by actual knowledge can the variation be detected. If a number of examples of the variation were placed in the hands of an observer, who, though otherwise competent, were ignorant of the particular animals or plants, he would detect nothing unusual in the variations given him. Speaking generally, Mr. Bateson finds that what Galton called positions of organic stability occur in variations. Just as in species there is a mean form, on either side of which slight irregularities taper off, so in most variations there is a normal or mean form, round which slight irregularities of the variation cluster. This suggests to him that the discontinuity in species may be an expression of the discontinuity of variations. Of course he puts forward this view, not so much as an actual solution, as a direction in which the study of variation may profitably proceed. He suggests, in fact, that it is worth while enquiring whether the definiteness of animal and plant types be not due to the physical limitations of variation rather than to adaptation to environment. In connection with this, he draws attention to the obvious fact that as growth depends upon cell-division, many of the problems of organic structure may resolve themselves into problems of the physiology of division. Similarly, in questions of qualitative change, questions of what he calls substantive variation, many of the problems will resolve themselves ultimately

into chemical problems. Chemical compounds are themselves discontinuous, and if the chemical nature of a substance be altered at all, it will be changed either inappreciably or completely.

After this introductory matter, which alone can be treated of at any length in a short account of Mr. Bateson's book, the author passes directly to the exposition of the large number of cases of meristic variation he has examined. These are arranged under various natural headings, and are described under consecutive numbers, so that future additions and references can be made very simply. It is impossible to exaggerate the skill and care with which this has been done, and there can be no question that a most excellent introduction to the study of variation has been written.

Although it is quite certain that a just appreciation of the value of the general conclusions Mr. Bateson foreshadows can be reached only after a long study, not only of Mr. Bateson's careful descriptions, but of actual specimens, a few of the many considerations suggested by the book may be set down. The more one studies his book, the more one is struck by the always present and occasionally avowed placing in juxtaposition of the discontinuity in species and the discontinuity in variation. In more than one place Mr. Bateson suggests definitely that the former finds its explanation in the latter. Most will agree that the author over-estimates the value of his suggestion. Take first the facts upon which the so-called discontinuity in species depend. Although, in many cases, it is merely an assumption of palæontologists that those animals which can be arranged in a structural series necessarily constitute a series in descent, yet in many cases—as, for instance, in Ammonites—series of descent upon almost undoubted evidence have been shown to exist; and these series show that the evolution of species took place, not *per saltum*, but by continuous modification. We do not expect to find complete records of continuous descent; but the imperfection of the record is necessarily so great, that unless descent by simply-graded modifications were the ordinary history, it would be almost inconceivable that so close simulation of such an occurrence as has been shown to exist could exist. Moreover, the palæontological record explains so many cases of geographical distribution, that it seems quite unnecessary to make so much difficulty about the present occurrence of most nearly-allied species in the same localities. Nothing has been established more certainly than that existing distribution depends upon so many slight changes in the immediate and in the remote past, that the present occurrence of species is absolutely no guide to their original habitats. Temporary geographical isolations of parts of species repeatedly occur, and as repeatedly disappear. We have much evidence that goes to show that the great land areas of the world have remained comparatively constant in position, but that there have been repeated changes from continents to archipelagoes and back again to continents. We have direct evidence as to the effect of geographical separation in producing divergence. Putting the two together, we have good reason to suppose that groups that have become divergent when separated, have been thrown together again. Anyone who is familiar with the physical changes of a country side in the very few years that cover the observations of one individual, must know of changes in the distribution of the most common animals and plants. This knowledge may not be, and probably is not, enough to solve the problem of the co-existence of different forms closely allied; but it is enough to give pause before finding in the co-existence of such species a problem that can be solved only by the assumption of a discontinuous origin.

But in drawing his contrast between the continuity of the environment and the discontinuity of species, Mr. Bateson attaches a curiously limited meaning to the term environment. It is quite true that in the same spring weather, in the same fields, and on the same flowers, lady-birds differing in striking but apparently unimportant details may be found, and side by side under the same stones dimorphic earwigs occur. No doubt such instances could be multiplied almost indefinitely wherever observers so careful as Mr. Bateson are at work. But can we deduce from such facts as these the necessity of abandoning continuity in the modification of species? If there is a struggle and a selection of the more favoured individuals, there are a thousand elusive factors in the environment that may be determining the existence of the animals. A slight difference in the power of resisting bacteria, a change in physiological habit that would write no mark upon the visible form of the creatures, and many another factor overlooked by us, might well be the determining cause of the animal's existence. These, no doubt, are all hypotheses, but it is not a hypothesis to say that we are too ignorant of the relations of any animal or plant to its environment to conclude that discontinuous forms of life arise or exist in a continuous environment, and therefore to seek explanation in discontinuous factors. When, moreover, one remembers that each animal or plant is an organic whole, and that selection of an invisible character must bring with it selection of many visible characters, it is plain enough that, although the characters which arrest our attention bear no intelligible relation to what we know of the environment, we need not abandon old methods and known causes to seek new and unknown causes.

Turning now to discontinuity in variation, it is to be noted that Mr. Bateson himself explains again and again that what he calls discontinuity is merely a necessary result of growth, or of chemical constitution. An embryonic cell divides, or it does not divide, and there results in the adult two organs or one organ, but not one and a half. A pigment is chemically altered, or it is not chemically altered, and there results a new colour, or the old colour, but not a series of intermediate shade. Such instances, however valuable as part of existing nature, do not, however, so much as touch the every-day instances of slight gradation and undoubtedly continuous variation that are to be observed in the shape and size of various parts. Moreover, as Mr. Bateson himself is careful to note, no adequate evidence is yet forthcoming with respect to the inheritance of discontinuous variations. In short, what Mr. Bateson has really done in his most interesting book is to collect and formulate a large amount of information about the laws of growth. He has shown clearly what naturalists are accustomed to neglect. The body of any animal or plant forms an organic whole. The various organs and structures are correlated together just as physiologists have shown that the various functions of the body are correlated together. In the case of physiological facts, there is as yet little guidance for us in attempting to understand how the correlations are affected. Mr. Bateson has shown how, in many cases, the structures that build up the symmetrical organism are correlated; he has brought out clearly the most striking fact that variations are not irregularities, but that they are as regular, and as harmonious, as the ordinary conditions of organisation. Indirectly, this will no doubt serve to explain the apparent discontinuity in species by showing that, as Mr. Bateson says, the integral stages by which

variation proceeds are larger than we supposed. But it will also serve to make the apparent discontinuity less striking by directing our attention to the immense importance of the laws of growth in normal structures, as well as in abnormal ones. I do not think that his book so much suggests, as he supposes, that the discontinuity of species may be a consequence and an expression of the discontinuity of variation, but that the apparent discontinuity found both in variation and in species will seem less and less as we understand more the physical limitations by which the growth of organisms are determined.

P. C. M.

AN ENGLISH BOTANY TEXT-BOOK.

A STUDENTS' TEXT-BOOK OF BOTANY. By S. H. Vines, M.A., D.Sc., F.R.S. (First half.) 8vo. Pp. x., 430, with 279 illustrations. London: Swan Sonnenschein & Co., 1894. Price 7s. 6d.

WE have waited a long time for Dr. Vines' text-book, and, while welcoming the first portion, fervently echo the hope expressed by the publishers on the back of the cover, to wit, "that the remainder of the work, together with the Index, etc., will be ready for issue in the course of the year." The book has grown out of the author's English edition of Prantl's *Lehrbuch*, but growth has implied a change in form as well as increase in bulk, and to such an extent that "the present is essentially a new and distinct work," and, consequently, bears only Dr. Vines' name on its title-page. The older work, issued in 1880, contained 344 pages and 275 woodcuts; the first half of the new one contains nearly 100 pages more and 279 cuts; moreover, the scope of the book has been so extended that, while retaining all that has made it of value to beginners, it may also be useful to those engaged in the advanced study of the science.

A text-book is generally regarded as nourishment for the student who is feeding up for examination, or has a worthy desire to get a good general knowledge of botany before specialising in some one of its many branches. But it should have a wider use, as a tonic for specialists, and a corrective for the evils arising from work in a too confined space. Workers in different fields would be more in touch with each other if their knowledge of the general principles in the great divisions of morphology, physiology, and classification was kept fairly up-to-date; besides which, they would take a broader view of things, and make fewer blunders, while the value of their work would be enhanced accordingly. This puts a heavy responsibility on the shoulders of the text-book writer, and exposes him to universal criticism, but might also have the salutary effect of suppressing, if he is suppressible, the ever-recurring individual who, having realised a long-felt want, hastens to supply it with a compilation badly planned and feebly executed.

Dr. Vines' text-book is the first that modern botany has produced in this country. We have text-books, and good ones, like Sachs and Goebel, but they have been only translations of German works, native talent exhausting itself in the addition of a few foot-notes and a glossary at the end. It is matter for congratulation that originality in this line has not been utterly quenched. No botanist is so well fitted for the task as Dr. Vines, and the portion of the text-book already produced is admirable. It includes Part I., on Morphology; Part II., on the Intimate Structure of Plants (Anatomy and Histology); and that portion of Part III., the Classification of Plants, comprised under the old term Cryptogams including the

groups Thallophyta, Bryophyta, and Pteridophyta. We notice at once a departure from the plan of the edition of Prantl, where the chapters on physiology followed, we think more naturally, those dealing with anatomy and histology.

Speaking of physiology we are reminded of the author's text-book on the subject, with which in one respect his more recent effort compares unfavourably. We mean in mode of expression. The "Physiology" was pleasant and comparatively easy reading, but the students' text-book is stiff, and bristles with technical terms, many of which will be new and strange even to the student who left off text-books less than seven years ago. This is most noticeable in the anatomical part. Thus, the plant unit is an *energid*, which becomes a cell only when invested with a cell-wall. An aggregate of energids, *e.g.*, the body of a *Vaucheria*, is a *coenocyte*, and *coenocytic* structure is thus contrasted with cellular; but we have also to distinguish the multinucleate cell, which from being uninucleate has become multinucleate by direct nuclear division, from the *syncyte*, a structure developed from already-formed cells by a more or less complete absorption of the separating walls, such as occurs in the development of vessels. The employment of the term *stele* for the tissues derived from the plerome entails a number of derivatives such as *polystely*, *schizostely*, *gamostelic*, *meristele*, etc., which will make the botanist to whom we have referred feel quite ancient.

We like the part on morphology best, and note especially the able way in which the more highly and more lowly organised plants are considered from one broad point of view. The extension of *root* and *fruit* into cellular plants, and a more general use of some other terms helps to break down the exclusive barrier which has too severely separated the larger groups. In treating of the leaf, the author adopts Bower's view of differentiation along a longitudinal axis, or *phyllopodium*, into *hypo-*, *meso-*, and *epi*-podium, the first forming the leaf-base, including the sheath, stipules, and pulvinus, the second the stalk, while the third is generally winged, forming the blade. When we consider the extremely close relation between the parts, and the frequent impossibility of accurate distinction, as well as the continuity of structure, these divisions seem somewhat arbitrary. A very admirable chapter is that on the cell, which forms a splendid introduction to the anatomical section. We notice, however, a slip on p. 112, where it is stated that "the proteid grain always contains a mass of mineral matter," a statement disproved by some work done in Dr. Vines' own laboratory at Cambridge.

The most noticeable features in the portion dealing with classification are the separation of *Isoëtes* from Salviniaceæ as a distinct order of Heterosporous Eusporangiate Filicinæ, and the well illustrated account of the embryogeny of the lycopods.

We sincerely hope that the "Students' Text-Book," by the production of which Dr. Vines has increased the obligation the botanical world already owes him, will not long remain incomplete.

British Glaciation.

Papers and Notes on the Glacial Geology of Great Britain and Ireland. By the late Henry Carvill Lewis, M.A., F.G.S. Edited from his unpublished MSS., with an introduction, by Henry W. Crosskey. Pp. lxxxi. and 469. 82 figures and 10 maps. London: Longmans, 1894. Price 21s.

Among all the vexed questions in British geology none has been the subject of more divergent theories, faddy speculations, and prolific

literature of the type which Haeckel would call "phaulographic," than the interpretation of the series of sands and clays which are generally regarded as due to the action of some form of ice. The chaos has resulted from various reasons, among the chief of which are the facts that the sections are usually open temporarily so that only local workers can follow them, that comparatively few have the opportunity of studying ice in action at the present day, and that the subject has suffered from an extra crop of faddists and theorists. There is probably no branch of stratigraphical geology which requires that its students should have examined the deposits over such wide stretches of country, for they vary so greatly within very narrow limits. It was therefore highly desirable that some well-trained geologist should go over the whole of the ground, in order to collect data for an authoritative expression of opinion; English students were accordingly glad to welcome Professor H. Carvill Lewis when he entered upon this task. He brought to it very special qualifications; he was a man of untiring energy and remarkable keenness of observation; he was a petrographer as well as a physical geologist, so that he was able to recognise the erratics he had to study; he held, moreover, the great advantage of a training in the glaciation of America, where he had been able to examine enormous extents of glacial deposits in a region where the agency of floating marine ice could not be invoked. It was objected that he was a theorist, but this, after all, only meant that he was a man of ideas, and had the imagination necessary to enable him to interpret the descriptions of others, and allow for the misrepresentations due to inexperience, carelessness, and fads. The readiness which he always showed to abandon his old position as soon as facts rendered it untenable testified to his fairness and showed that he was not a man of blind prejudices. Hence, when the news spread that he had fallen a victim to the fell disease of typhoid fever at Manchester, just after he had landed for a fourth campaign in July, 1888, it was universally admitted that glacial geology had suffered an irreparable loss. And this was felt the more keenly by all who had come within the range of his personal influence, and knew the manly frankness, the contagious enthusiasm and energy, and the manifest sincerity which gave his character a singular fascination.

How much we have lost by the death of Professor Lewis, this volume helps us to realise; for it shows us what an amount of material he had collected, which now has to be published in a somewhat scrappy form. The work, however, is much better than some had expected, and for this we have to thank the editor. Much anxiety was felt when it was first announced that Professor Lewis's manuscripts had been left to Dr. Crosskey for him to edit, as this seemed like asking the Pope to edit Luther's tracts; for Dr. Crosskey had generally been regarded as one of the most conservative of the older school of glacial geologists and one of those most opposed to the views of Professor Lewis. Dr. Crosskey, however, did his task in a manner that deserves the highest admiration. He refused to "criticise," and confined his labours to those of arrangement, elucidation, and editing. This he has done, not only with a wide knowledge of the subject and a sound literary judgment, but with feelings of affectionate sympathy with his heretical young friend. He has contributed an admirable introduction of 49 pages, giving a sketch of the general results of Lewis's work, which shows how deep an influence the latter's views had had in England in a quarter where it was least expected.

When Professor Lewis came first to England the generally-accepted theory was that this country had twice been covered by a vast ice-sheet, and in the interval between these had been submerged to the depth of over 1,400 feet at the very least. One school occupied the extreme position of denying the influence of land-ice in any form, and explained the whole thing as due to icebergs drifting southward during a period of submergence; this view, however, was very restricted in its distribution, and there was an overwhelming majority for the orthodox side. A few men had advocated other views, notably J. G. Goodchild and T. Belt; they believed in one ice-age, denied any submergence, except locally to a very small amount, maintained the power of ice-sheets to raise boulders and frozen masses of shell-beds from lower to higher levels, and realised the effects of the differential movements that must occur in ice-sheets flowing over uneven surfaces. But these teachers had exerted barely any perceptible influence; their views was based on the complexity of the conditions of glaciation, whereas geologists preferred to regard these as very simple. Goodchild's remarkable paper on the "Glacial Geology of Edenside" appeared in 1875, but it was before its time and was practically ignored.

In opposition to the orthodox theory, Professor Lewis advocated the unity of the ice-age, at least until his discovery at Frankley Hill, and strenuously opposed the great submergence. He admitted that the north of England and Scotland had subsided for about 150 feet, and attributed all the deposits formed by water above this level to the action of either lakes or subglacial streams. The shells, he thought, worked their way up through the ice in frozen masses, just as boulders do through the Swiss glaciers. These views are expressed in the volume in five short papers. These are entitled, "Comparative Studies upon the Glaciation of North America, Great Britain, and Ireland"; "The Terminal Moraines of the Great Glaciers of England"; "On some Important Extra-Morainic Lakes in Central England, North America, and elsewhere, during the period of Maximum Glaciation, and on the Origin of Extra-Morainic Boulder Clay"; "The Supposed Three-fold Division of the Drift"; and "The Direction of Glaciation as ascertained by the form of the Striæ." These essays, however, he left only in abstract. Most of the volume consists of his field notes, and contains descriptions of sections and country in many parts of Ireland, England, and Wales. The districts that he knew best, and where he has added most to our knowledge, are the south-west of Ireland and northern Donegal, Shropshire,and South Lancashire; his description of the sections in these localities must prove of great service to English geologists.

One of the principal difficulties in using this part of the work is the varying meaning attached to the same term, and the frequent changes of position which were necessitated by increasing knowledge, and no one can read the volume without feeling what we have lost by the fact that Professor Lewis did not live to state his case finally and fully in the light of his latest conclusions. Many of the views expressed we know he modified the year before his death, and he had come to England to re-investigate the changes that were inevitable after his abandonment of his view of there being but a single glaciation.

But in spite of his early death he had lived to do much. He had unquestionably cleared the ground of many stumbling blocks.

He showed, for example—and Kendall's recent study of the sections exposed by the Manchester Ship Canal support it—that the old view of the three-fold classification of the drift into an upper and a lower boulder clay, separated by sands, is absolutely untenable; that even within very short distances this supposed sequence is often reversed, and we may get the boulder clay in the middle, with sands above and below. A second point of great importance was his insistence on the influence of water in depositing and arranging the glacial materials: it may act in the form of subglacial streams or lakes, which are either upon or in front of the glacier. Probably, however, Professor Lewis's most important contribution to British geology has been the practical annihilation of the theory of the submergence of England to the depth of 1,400 feet in an interglacial period. This theory he once characterised as "the most pernicious one ever propounded in geology" (p. 375), and against it he never ceased to wage war. That probably not one of the younger English geologists now believes this theory is, practically, entirely owing to the work of Professor Lewis. To have laid this bogey was itself a most brilliant achievement.

There are a few points, however, in which Professor Lewis seems to have overstated his case. Thus his law that "every glacier is bounded by a terminal moraine," is not likely to be generally accepted; it was founded at the time when it was confidently expected that the moraines of the Eastern States of America would be found to extend right across the Central Plain and unite with the old moraines of the Rockies. But now that it has been proved that this is not the case, and that the extra-morainic fringe is more extensive that was once thought, this view cannot be accepted as Professor Lewis stated it. A still more important point was his former denial of the existence of more than one glaciation, and his refusal to admit the action of land-ice for the Essex Boulder Clay, which was a natural corollary from the former. His examination, however, of the Frankley Hill sections convinced him that there have been two glaciations, and that his "terminal moraines" were all formed in the later. It is, therefore, highly probable that if he had examined some of the Essex sections after this, he would have accepted the Boulder Clay there as a true till belonging to the earlier glaciation; he would not then have attributed it to an extra-morainic lake, though the glacial gravels of this district are probably formed by some such agency. It is impossible to regard the scattered denuded remnants of the South Essex Boulder Clay as synchronous with the comparatively unweathered moraines of the Lake District and Wales. The acceptance of a double glaciation removes the most serious of the objections to Professor Lewis's hypothesis.

The volume is well printed, and has been most carefully edited. The explanations and notes of Dr. Crosskey and Mrs. Lewis, and a valuable appendix by Mr. Kendal, strengthen and remove doubts from Professor Lewis's position. The maps and sketches are clear and instructive, though some improvements might easily have been made in some of the former that would have made them more in accordance both with the facts and Professor Lewis's theories. Had a few such alterations been made, they would have been of more service. The only two serious regrets we feel are, that there is no index—the list of contents is, however, a full one—and that the volume has not been adorned with a portrait of its author.

J. W. G.

Science and Sport.

Big Game Shooting (Badminton Library). By Clive Phillipps-Wolley. With Contributions by Sir Samuel W. Baker, W. C. Oswell, F. J. Jackson, Warburton Pike, F. C. Selous, Lieut.-Colonel R. Heber Percy, Arnold Pike, Major Algernon C. Heber Percy, W. A. Baillie-Grohman, Sir Henry Pottinger, Bart., Earl of Kilmorey, Abel Chapman, Walter J. Buck, and St. George Littledale. 8vo. 2 vols., illustrated. London: Longmans & Co., 1893. Price 10/6 each vol.

That a book on Big Game Shooting, written professedly for the sportsman, should contain such a large amount of natural history, for the most part excellently written and well up-to-date, as the one before us, is a sign that sportsmen are taking a genuine interest in zoology, and that their sole aim is no longer the making of the biggest bag, or the securing the finest trophies. How heartily we welcome this change from the old state of affairs it is unnecessary to mention, but we hope the appearance of this most excellent work will aid in stimulating all the slayers of Big Game to use their unrivalled opportunities of adding to our knowledge of the habits and distribution of the animals they pursue. If we might add an additional plea, it would be that they would incur a further obligation on the part of the working naturalist if they would occasionally give us some notes on the life-histories of other little-known creatures, not coming under the title of Big Game, which they must frequently come across in the course of their wanderings. Such observations take but little time to record, and will often serve to fill up an idle hour in camp.

The large field covered by the work before us will be well seen from the titles of the chapters, which are as follows:—On Big Game Shooting generally, by C. P. Wolley; South Africa Fifty Years Ago, Second Expedition to South Africa, Later Visits to South Africa, and With Livingstone in South Africa, all by W. C. Oswell; East Africa—Battery, Dress, Camp-Gear, and Stores, Game Districts and Routes, The Caravan, Headman, Gun-bearers, etc., Hints on East Africa, Stalking, Driving, etc., the Elephant, the African Buffalo, the Lion, the Rhinoceros, the Hippopotamus, Ostriches and Giraffes, Antelopes, all by F. J. Jackson; the Lion in South Africa, by F. C. Selous; the Big Game of North America, the Caucasus, the Mountain Game of the Caucasus, all by C. P. Wolley; the Musk-Ox, by W. Pike; Arctic Hunting, by Arnold Pike; the Caucasian Aurochs, the *Ovis argali* of Mongolia, and the *Ovis poli* of the Pamir, by St. G. Littledale; the Chamois, and the Stag of the Alps, by W. A. Baillie-Grohman; the Scandinavian Elk, by Sir Henry Pottinger; European Big Game, by Major A. H. Percy and the Earl of Kilmorey; the Large Game of Spain and Portugal, by Abel Chapman and W. J. Buck; and Indian Shooting, by Lieut.-Col. R. H. Percy.

Among these chapters, especial interest attaches to the one by the late Mr. Oswell, on the condition of Africa, and the swarms of its big game half-a-century ago; although we can but recall with regret that such an excellent observer should have been one of those who assisted to no inconsiderable extent in the extermination of the so-called white rhinoceros. And here we take the opportunity of calling attention to the unrivalled excellence of the illustrations by Mr. Charles Whymper, with which the volume is embellished, some of these giving a better idea of what South Africa used to be in its palmy days as a big game country, than any others that have come under our notice. What more particularly strikes us is the fidelity to nature with

which such small-sized photographs have been executed, the species of every animal portrayed being recognisable at the first glance.

Among the other chapters it is almost invidious to make a selection; but Mr. Jackson's chapter on the antelopes of East Africa, from a naturalist's point of view, strikes us as particularly good; while the one on the big game of India, by Colonel Percy, must certainly come in for a share of commendation. In a work like the present it is not likely that a naturalist would find much that is absolutely new to him; but there are many points that are worthy of his attention. In the first place, we believe it is not generally known that leopards inhabit the Caucasus, but if we are to credit the evidence recorded on page 43 of the second volume, it appears that we must admit this to be the case. Another point of interest is the opinion that the African elephant was never tamed by the Carthaginians, the coins with the effigy of this animal upon them having been struck long after Carthaginian times, and the animal even on these being a kind of mongrel. More probably the elephants which the Carthaginians undoubtedly possessed were imported Indian animals. The maximum height of the African elephant recorded in this work is 12 feet 2 inches, and the extraordinary numbers in which these giants formerly occurred in South Africa is graphically described on page 129 of the first volume. The subject of height reminds us that a maximum of 18 feet is assigned in this work to the giraffes although Mr. Bryden has assured us by letter that he has measured, a specimen of 19 feet. We confess that we should like further information on this subject; more especially as the apparently gigantic stuffed male from South Africa in the British Museum measures only 17 feet 4 inches.

In another work Mr. Selous has rather thrown cold water on the idea that the African buffalo is a ferocious animal, but in the volumes before us Mr. Jackson fully supports the view that the creature is decidedly an ugly customer to encounter. That the African rhinoceroses attack, as might have been supposed from the absence of front teeth, with their tremendous horns, is fully demonstrated; but it is perhaps less generally known that the Asiatic species use the lower tusks as their weapons of offence, in the same manner as a pig. The recorded occurrence of the Sitatunga antelope from Uganda is, if we mistake not, a new fact in distribution.

The foregoing references are sufficient to indicate the highly interesting nature of this most excellent treatise on Big Game, which we can heartily commend, not only to the attention of the sportsmen for whom it was primarily intended, but likewise to everyone interested in the habits and mode of life of these largest efforts of creation.

If we were in the mood for fault-finding, which we are not, we should discover but little to blame in the work as a whole. May we, however, suggest to the editor that in the next edition he should exercise his editorial powers a little more energetically, in order to prevent discrepancies. For instance, we find on page 76 of the second volume Mr. St. George Littledale lamenting that naturalists have not decided on the synonymy and number of species of the big Asiatic wild sheep; while on page 291 of the same volume Colonel Percy quotes at length Mr. Blanford's well-known and decisive observations on this interesting subject. Again, it would be well if the editor were to take into his council some zoologist of repute who would aid him in the thorny subject of nomenclature; and if this were

done we should not in the second edition see the wild goat of Persia described and figured on page 52 of vol. ii. as *Hircus ægagrus*, although alluded to on page 321 by its proper title of *Capra ægagrus*. Neither should we find the saiga mentioned on page 44 of the same volume, and the chamois on page 176, under the generic name of *Antilope*.

These are, however, but trifling blemishes in a most excellent work, which will long be the standard on the subject of which it treats, and reflects credit alike on its editor and its contributors, as well as on the artists and publishers.

The Chemistry of Animals.

The Essentials of Chemical Physiology for the use of Students. By W. D. Halliburton, M.D., F.R.S., F.R.C.P., Professor of Physiology in King's College, London, etc., etc. Pp. 166. London: Longmans, Green & Co., 1893. Price 5s.

In the records of research and in advanced treatises the most certain and the newest discoveries are so held in solution that only an expert can detect them. But when a brilliant investigator and competent teacher like Dr. Halliburton writes a text-book for students, we expect to find that his mind has acted on the confused details of his science so as to precipitate and render obvious the most important truths. It requires small effort to see that Dr. Halliburton regards it as of the first importance to impress on students that in chemical physiology they are concerned with living organisms. Natural Science from time to time has called attention to the growth of what is called "Vitalism" in physiology, and here in that citadel of the mechanical school—the chemistry of the animal body—one finds the new doctrine entrenched. Consider what one was taught even a few years ago. The body was a collection of specialised organs, each organ with its own function or functions. The blood was a mechanical channel of connection between the organs. The food was taken into the alimentary canal and the various digestive juices acted upon it so that insoluble substances were turned into soluble. These latter passed by osmosis into the blood directly, or through the lacteals. By the blood they were handed on to the different organs, in each of which certain chemical processes went on. In the lungs oxygen diffused in, carbonic acid diffused out, and the reverse process took place in the tissues. Wherever a direct mechanical or chemical comparison could be made it was adopted as an explanation. Elaborate tables abounded, showing the transformation of so much food material into so many grammes of fat and glycogen and proteid; calculations were made showing the work to be expected from the oxidation of so much proteid and carbohydrate and the corresponding production of waste products.

Here all these matters are in the background, being replaced by the microscopic appearances of the cells and tissues; and the idea that all the processes are vital processes occurring in living protoplasm is insisted on. In digestion, no doubt, insoluble starches are turned into soluble sugars, insoluble proteids into soluble peptones; fats are emulsified and saponified. But these do not diffuse into the blood; they are "eaten" by the living cells of the alimentary canal, and these, neglecting diffusibility or indiffusibility, select what they want not even systematically but with varying caprices. Indeed if soluble peptone be injected into the blood, into which it used to be thought to soak, poisonous effects

are produced and the animal may die. The epithelial cells of the alimentary canal protect us from these poisonous effects by turning back into insoluble proteids the peptones they absorb. Again, sugar injected into the blood passes into the lymph, but soon the percentage in the lymph is higher than the percentage in the blood—a result which cannot be explained by filtration or diffusion, and must be due to the "secretory activity" of the cells of the vessel walls. Even the vital action of the cells of the intestine does not alone perform the work of digestion. The process is aided by multitudes of bacteria that thrive where the antiseptic gastric juice has deen neutralised by the fluid from the pancreas.

Another striking "vitalistic" occurrence is the excretion of carbonic acid by the lungs. The tension of carbonic acid in the air in the alveoli of the lungs is much lower than the tension of carbonic acid in the veins. Hence it seems a simple physical process that carbonic acid should pass from the veins to the alveolar air. But the process goes on so far that when the venous blood has become arterial, the tension of the carbonic acid is lower in the blood than in the alveolar air. Here again secretory activity of the epithelium lining the pulmonary alveoli is called into account.

Some of the other changes from the physiological chemistry of our youth are equally striking. Thus, a large number of the so-called chemical processes depend on unorganised ferments; that is to say, on ferments possessing the characters of living things, except that they cannot be identified as separate organisms having shape, size, and so forth. Of these, some we know, others are more recent discoveries. Ptyalin of the saliva, pepsin and rennet of the stomach, trypsin, amylopsin, and steapsin of the pancreas, and the fibrin ferment in the white blood corpuscles, all are appeals from chemistry to vital action.

The organs and tissues of the body are bound together in much more than a mechanical fashion. Experimental evidence has shown that, in addition to its own special functions, each organ contributes in a vague way to the "general metabolism of the body." The expression of the fact is vague, but the fact is real and striking. Extirpation of the testes causes many well-known general changes in addition to the special change of impotency. And so extirpation of other organs brings about many general changes over the whole body in addition to loss of the special.

The special functions of organs are not the simple occurrences formerly believed in. For instance, urea is not formed in the kidneys, not even in the muscles, but in the liver; while, on the other hand, bile is not a digestive fluid but probably purely excretory.

We advise strongly those who are working in other branches of Biology to read Dr. Halliburton's clear and interesting little book. Many problems await their solution by the joint action of morphological and physiological considerations, and we recommend morphologists in particular to notice the paths along which the students of function are travelling.

It remains to be said that from the point of view of students Dr. Halliburton's book is admirable. The directions for practical work at the beginning of each section are explicit and simple; even dull students should require little further direction. The descriptions of apparatus are very clear, and if they are studied not directly from the figures in the book but with the apparatus in the laboratory, much time will be saved from the teaching of physics for the teaching of physiology.

THE FAUNA OF THE DEEP SEA. By S. J. Hickson, M.A., D.Sc. Modern Science Series. Pp. xvi., 169. London: Kegan Paul, Trench, Trubner & Co., 1894 Price 2s. 6d.

IN this interesting little book, which we are prevented by its title from calling superficial, Dr. Hickson deals in a readable and commendably brief way with recent enquiries into the nature and habits of animals living at great depths. The subject is alluring to everybody, and the "general reader" will, we imagine, not be disappointed with what Dr. Hickson has to offer him. The more seriously minded and expert reader will not of course expect a detailed discussion of the problems arising out of the facts. Nor would they indeed be entirely in place in a short epitome of this kind. Dr. Hickson begins his preface by saying, quite melodramatically, that "a time may come" when the bottom of the sea will be thoroughly known. At present it is as he justly, though hibernically, intimates a large *terra incognita*. Still a fair amount is known, and mainly, as everybody admits, through the results of the "Challenger" voyage. The uninstructed devourer of Mr. Hickson's pages will be struck with the satanic aspect of many of the deep-sea fishes. The piscine countenance is not formed for the presentation of beauty, but it is rarely that such malevolence is to be read there as in the case of these particular fishes. Moreover, the reader will also learn that the features are an index to the dispositions of their possessors. So ferociously carnivorous are some of these fish that they will without the least hesitation swallow a neighbour ever so much larger than themselves. Kindly nature, who in this quarter of the world is particularly "red in tooth and claw," has aided and abetted them in this course of action by endowing them with unusually extensile stomachs. Their voracity, however, is not always unpunished; for many other animals, which would be liable to fall victims to these cannibals, have put on an extensive armature of spines; anyone who consults the sumptuous plates of the "Challenger Monographs" will soon meet with figures of crustacea which are only to be compared with hedgehogs. Luckily there is a limit to this indiscriminate feeding off one another in the deep sea, or its fauna would by this time have arrived at the condition of the crew of the "Nancy Bell." Some years ago Dr. Moebius wrote a paper entitled "Wo kommt dann die Nährung der Tiefseefauna aus?" in which it was sought to prove that the animals of the abysses chiefly depended upon the surface waters for their food-supply. From them there falls a constant and abundant rain of the dead bodies of minute surface-creatures such as Diatoms and Foraminifera, which are snapped up by the animals at the bottom. In reviewing the facts concerning the deep-sea fauna with an eye to generalisations, one is struck by the contradictory nature of the evidence. The environment seems to have acted differently in various cases. For instance, the gills of the deep-sea fishes are shrunken and comparatively rudimentary. On the other hand, the very same cause has produced in other animals the reverse condition. Milne Edwards remarked upon the enormous development of accessory gills in his gigantic Isopod *Bathynomus*; and another Isopod belonging to the same family, *Anuropus*, has the last pair of abdominal appendages converted into gills. In some groups of animals the deep-sea representatives are shrunken and dwindled in size as compared with their shallow-water allies; in other groups the very largest members known hail from the deep-sea; *Bathynomus* is an instance of the latter statement. There is thus a good deal to do in the way of collating the abundant facts at

our disposal, which will furnish in all probability good material for deciding on the merits of Natural Selection as opposed to environmental influence.

AN INDEX TO THE GENERA AND SPECIES OF THE FORAMINIFERA. By Charles Davies Sherborn. Part I. (A to Non). From Smithsonian Miscellaneous Collections, vol. xxxvii. (No. 856). 8vo. Pp. ii., 240. Washington: Smithsonian Institution. 1893.

THE Smithsonian Institution has often deserved well of the working naturalist by the publication of works troublesome to prepare and costly to print, appealing to no wide public, but invaluable to the few that are able to appreciate them. In no case will gratitude be more profound or more deserved than that which will come to the Institution in return for the issue of this Index. The labour involved in the production of such a work is sufficiently clear to anyone who casts his eye down one of its closely-printed pages, and is also evidenced by the fact that this, the first half, has taken nearly as long to print as the whole index took to prepare. The work is practically a systematic index to all the literature published on Foraminifera up to the end of 1889, and refers not merely to every published name, but to many names not properly published, to many published instances either not named or not referred to Foraminifera at all, and to other instances that have been erroneously placed in this group. The author does not profess to determine the synonymy of the different species, since this would introduce the element of personal opinion, which, even in the case of so approved an authority, might occasionally be erroneous. Almost the same end is, however, attained by the citation of previous opinions, and by the extraordinarily complete system of cross-references. The value of a work like the present is almost entirely dependent on the two qualities of accuracy and completeness. Those conversant with Mr. Sherborn's "Bibliography of the Foraminifera," a book of constant service to the librarian, the bibliographer, and the scientific writer, know that no one has a fuller acquaintance with the literature of his subject; while Woodward and Sherborn's "Catalogue of British Fossil Vertebrata" is sufficient testimony to the accuracy of the compiler.

We cannot dilate on this monument of enthusiastic industry, since it appeals to the specialist rather than to the general reader. But we would urge all who contemplate similar publications to take this as their model; and we hope that this example will lead many to imitate it for other classes of animals. Were all groups indexed in this manner, the labours of zoologists would be lightened of a grievous burden, and the wail of the synonym need no longer be heard in the land.

OTHER NEW PUBLICATIONS ON THE FORAMINIFERA.

THE samples of sea-bottom obtained by the German exploring ship "Gazelle" have been worked out by Dr. J. G. Egger, who has paid especial attention to the Foraminifera. Dr. Egger's monograph has recently been published in the Abhandlungen of the Bavarian Academy (vol. xviii.), and consists of 266 pages, illustrated by 21 quarto zincographs. These zincographs are sketchy, but serve their purpose admirably, because most of the forms have been described before. They are crowded with figures, and therefore present, for perhaps the first time, a valuable grouping of many allied forms in

one picture. This is especially well seen in pl. x., devoted to the Lagenæ, and pl. xiii., devoted to the Globigerinæ, and helps the student to realise how intimately related all the so-called "species" are, and how difficult it is to attempt to draw specific distinctions when whole series of these lowly organisms are obtained. Fornasini has just published a paper on the Costa and Seguenza collections in the Naples Museum (*Mem. R. Accad. Sci. Ist. Bologna*, ser. 5, vol. iv.), which were collected from the Tertiary marls of Messina. His paper deals chiefly with the Nodosariæ and Cristellariæ, and the three beautiful plates of outline drawings leave nothing to be desired. Dervieux has also published in the *Boll. Soc. Geol. Ital.*, vol. xii., part 4, a paper on the Tertiary Nodosariæ of Piedmont, in which 64 forms are carefully described, and illustrated in one plate. There should be no difficulty now in identifying the numerous Tertiary forms of the genera, but students cannot be too strongly cautioned against describing supposed new varieties without the most patient study of existing literature, a study which, we think, is often neglected because of the trouble and time required.

The Study of Molluscs.

Introduction à l'Étude des Mollusques. Par Paul Pelseneer. 8vo. Pp. 216, figures. Reprinted [in advance] from the "Mémoires de la Société Royale Malacologique de Belgique, tom xxvii." (1892). Bruxelles: H. Lamertin, 1894. Price 6 francs.

Most works on elementary zoology are, as the author points out in his preface, behind the time, because it is not in the power of any single man to keep simultaneously abreast with the progress made in all the various branches of zoological science. Pending the time that such a work shall be produced, as the more advanced treatises often are, by the co-operation of specialists in the several groups, the student can frequently find much that he needs to know in monographs such as Graber's "Die Insekten," or Günther's "Introduction to the Study of Fishes," but no such work exists on the Mollusca, if we except Coupin's that appeared in 1892. This last is, however, more of a "cram book" than anything else, and was very much behind the time even when it was issued, so that it is hardly to be seriously reckoned with. Dr. Pelseneer's "Introduction," on the other hand, like all he attempts, is thorough, and though there are points on which we venture to differ from him, which are open to objection or criticism, there can be no doubt of its great value to all malacologists as a reference book, and as such it is cordially to be recommended. Indeed, we only wish that the systematic conchologists (the variety-mongers and mere collectors of shells may be left out of account as past praying for) could be induced to master some of the principles here so clearly set forth, since it could not fail to have a beneficial effect in widening their mental vision, and so rendering their labours more useful by imparting, to them at least, a tinge of true science.

This Introduction is framed, of course, on a zoological basis, and in some respects too exclusively so. The method of treatment is to give a succinct account, first of the Mollusca as a whole, and then of each class, or sub-class when that seems desirable, the sub-headings being:—(1) Morphology; (2) "Éthologie," which the author defines as the principal particulars concerning the conditions of existence, in other words, the habits and mode of life, for which "Bionomics" is a more appropriate term; (3) Bibliography; and (4) Systematic

Arrangement. The classes are taken in the following order:—Amphineura, Gastropoda, Scaphopoda, Lamellibranchiata, Cephalopoda.

The bibliography is only brought up to the commencement of 1892, and from internal evidence it would seem that the work itself does not contain, with the possibly sole exception to be presently referred to, any of the results of later researches; but for this the Société Royale Malacologique de Belgique, and not the author, must be held responsible, since it was prepared for their 1892 volume. Hence it comes that *Siphonaria*, which Haller showed in that year there were strong reasons for placing with the Opisthobranchiata, here still remains in Pulmonata. On the other hand, the internal nature of the shell of *Ephippodonta* only published, if we recollect rightly, last year in the *Proceedings of the Malacological Society of London*, has been included as an addendum under "Errata." In this last connection we miss, strange to say, all reference to Dall's remarkable *Chlamydoconcha* (1884), in which the bivalve shell is yet more completely concealed by the mantle.

On turning to the systematic part we speedily realise that Dr. Pelseneer is a "lumper," for which fact we are duly grateful; but while fully appreciating the worth of the main outlines of his classification and regretting that his phylogenetic tree has not been reproduced, we must, in some instances, differ from him *toto cælo* in respect to the arrangement of his families. To take one example, what possible justification is there for the following sequence (pp. 96, 97): — Paludinidæ, Cyclophoridæ, Ampullariidæ, Littorinidæ, Cyclostomatidæ, Rissoidæ, Hydrobiidæ, Truncatellidæ, Valvatidæ, etc.? A minor point for regret is that some of the names are not those accepted by most conchologists on legitimate grounds of priority—*e.g.*, *Chenopus* instead of *Aporrhais*.

It could do no harm either to allude to the fossil groups—*e.g.*, Ammonea, Hippuritidæ—in their approximate position in the series, more especially since the Belemnitidæ and *Spirulirostra* are cited on p. 178, without, however, any mention of the fact that they are no longer living forms. A paragraph, too, might with advantage be devoted to the structure of the molluscan shell itself.

The work concludes with a "Table des Matières," which may be made to do duty as a table of classification for the main groups, and with an admirable index.

The above noted shortcomings in this most excellent volume are not adduced from any wish to detract from its value, or in any spirit of captious criticism; on the contrary, merely in order to point the almost obvious moral that not only is it impossible for any single writer to produce a satisfactory treatise on Zoology as a whole, but that it is not even in the power of a specialist, however eminent in his branch, to deal with it single-handed in such wise as to bring it level with the modern requirements of the general zoologist, a task which can only be performed with anything approaching true completeness by the concerted action of several workers drawn from the museum, the laboratory, and the ranks of the field naturalists. Granted, however, the single worker, no one could have performed the task better than Dr. Pelseneer, nor is the late Dr. P. J. Van Beneden's report on it one whit too strong when he says: "Tous ceux qui s'occupent de malacologie que ce soit au point de vue de l'anatomie, ou de la physiologie, ou même simplement de la Conchyliologie, y trouveront des renseignements d'une importance réelle." (BV)[2]

OBITUARY.

WILLIAM PENGELLY.

BORN JANUARY 12, 1812. DIED MARCH 16, 1894.

ALTHOUGH Mr. Pengelly was for some sixty years a resident in Torquay, he was not a Devonshire man, his birthplace having been in the quiet little fishing town of East Looe, in Cornwall. It is not surprising that, with the surroundings of such a place, he should have acquired, as a lad, a strong attachment to the sea. Fortunately, however, the bent of his mind towards scientific studies led him to adopt the profession of a teacher, and while still a young man he established himself at Torquay. Here his enthusiasm for the acquisition of knowledge soon manifested itself in the activity which he displayed in developing the Mechanics' Institute; and a few years afterwards he suggested the formation of a local society for the study of Natural Science. It was, indeed, mainly due to Mr. Pengelly's energy that the autumn of 1844 witnessed the foundation of the Torquay Natural History Society. Over its early fortunes he exercised the most watchful care, and in 1851 he was induced to accept the office of Honorary Secretary, an office which he continued uninterruptedly to hold, to the unspeakable advantage of the Society, for not less than nine-and-thirty years. Under his guidance it became a scientific power in the county; year after year he lectured there, tincturing the locality with his own enthusiasm, and from the Society there ultimately sprang the Museum in Babbacombe Road, with its admirable local collections. In the reading-room attached to the Museum there fitly hangs an oil-painting of the man whose individuality is unmistakably stamped upon the entire institution—William Pengelly.

Everyone identifies Mr. Pengelly with the exploration of Kent's Cavern. To this cave he had been attracted soon after his settlement in Torquay; and as far back as 1846 he had assisted in its partial examination, as a member of a small and poorly-equipped Committee, appointed by the local Natural History Society. The work of this Committee tended to confirm the conclusions formed by MacEnery and afterwards by Godwin-Austen; but the age was far from being ripe for the reception of their views.

Twelve years passed, and a cavern in Devonian limestone was discovered at Windmill Hill, near Brixham. By this time scientific opinion was veering round to a more favourable quarter, and the

Royal and Geological Societies took immediate advantage of the discovery, by appointing and subsidising a Committee to explore exhaustively the untouched cave. On the shoulders of Mr. Pengelly fell practically all the work of supervision, but he had his reward in finding ample corroboration of his previous conclusions; for beneath the unbroken stalagmitic floor were brought to light relics of human handiwork in such intimate association with the remains of extinct mammalia as to place their contemporaneity beyond all cavil.

A change of attitude towards the great question of the geological range of Man having been thus effected, the eyes of many were again turned towards the depths of Kent's Cave, if haply they might yield fresh evidence bearing upon this subject. At the Bath meeting of the British Association in 1864, mainly by the influence of Sir Charles Lyell, who was then President, a powerful committee was appointed for the systematic exploration of the cavern; and of this committee—to borrow Professor Bonney's words—Mr. Pengelly was "the hands and the eyes, and, at least, a fair proportion of the compound brain." In fact, from the commencement of the work, on March 28, 1865, until its close, on June 19, 1880, Mr. Pengelly laboured with an untiring enthusiasm, which is attested by his long series of annual reports to the Association. One of the most important incidents in the course of this exploration was the confirmation—though not until the work had been continued for more than seven years—of MacEnery's discovery of the teeth of *Machærodus* in Kent's Cavern.

At the meetings of the British Association, Mr. Pengelly was always a welcome figure, whether in the Geological section or in the Anthropological department. Over the former he presided at the Plymouth meeting, in 1877, and over the latter at the Southport meeting, in 1883. On each occasion he discoursed, in his presidential address, on the Bone Caverns of Devonshire.

After the model of the British Association, Mr. Pengelly suggested the foundation of a Devonshire Association for the Advancement of Science, Literature, and Art. This was formed in 1862, and at the Barnstaple meeting, five years afterwards, Pengelly fitly occupied the presidential chair.

In order to settle the vexed question of the age of the Bovey beds, he undertook a systematic examination of these deposits, and in 1861 read before the Royal Society a valuable paper on "The Lignite and Clays of Bovey Tracey." At the same meeting, a communication was received from Dr. Oswald Heer, to whom the plant-remains had been submitted, "On the Fossil Flora of Bovey Tracey." These essays were reprinted, with a preface, as a monograph, in 1863; and although Mr. Starkie Gardner's subsequent studies of the Bovey flora have modified our opinion as to the age and origin of the deposits, Mr. Pengelly's work remains of great permanent value.

A fine collection of Devonian fossils from Devonshire and Cornwall, formed by Mr. Pengelly, was presented in 1860 by the Baroness

Burdett-Coutts to the Museum of the University of Oxford, in connection with the foundation of a geological scholarship, and is still known as "The Pengelly Collection." In 1863, Mr. Pengelly was elected a Fellow of the Royal Society, mainly in recognition of his work at Bovey and at Brixham; and in 1886 he received the Lyell Medal from the Geological Society—an award of singular fitness in so far as it commemorated the author of the "Antiquity of Man," who had been largely instrumental in securing the exploration of Kent's Cave. It is hoped that the memory of Mr. Pengelly may be suitably perpetuated, and to this end an influential Committee has been formed, including the President of the Royal Society, Professor Huxley, Sir John Lubbock, and Sir Douglas Galton, to consider a scheme for the provision of more Museum accommodation at Torquay.

Mr. Pengelly's scientific work was characterised by extreme honesty of purpose and thoroughness of execution; no amount of labour was considered too great for the elucidation of a detail which, to others, might seem insignificant. The work he undertook demanded accurate observation and sagacious inference rather than the gift of originality. Outside scientific circles Mr. Pengelly was at one time well known as a popular lecturer: his lectures were marked by much freedom of utterance and freshness of language, while they were certainly not lacking in one of the prime elements of success in public speaking—a touch of humour. To most people his geniality of presence was magnetic. In fact, many of us feel that, by Mr. Pengelly's death, we have lost one of the most clear-headed, quick-witted, and warm-hearted of friends.

F. W. R.

VERNON LOVETT CAMERON.

BORN 1844. DIED MARCH 26, 1894.

BY the death of Commander Cameron, owing to a fall from his horse at Leighton Buzzard on 26th March, we have lost another of the leaders of the "heroic age" of African exploration. He was born in 1844, and early entered the Royal Navy, and had his interest in African exploration roused while engaged in dhow-chasing off the East Coast of Africa. He was in Zanzibar when the Royal Geographical Society's Livingstone Relief Expedition broke down by the resignations of its successive leaders, Lieutenant Dawson, Lieutenant Henn, and Mr. New. He then proposed to organise another, and was commissioned by the Geographical Society to start to the relief of Livingstone, and then to solve the problem as to whether the Lualaba was really the head river of the Congo or the Nile. He left Bagamoyo early in 1873 with three other Europeans and a caravan of over 230 men. Though he succeeded in performing what was then the great feat of crossing Africa, the expedition was not a complete success. The caravan met Livingstone's body as it was being carried back to the coast, and thus the first object

of the expedition was frustrated; but Cameron resolved to push on and accomplish the second. This he had to do single-handed, for Murphy resolved to return with Livingstone's men, while Moffat had died near the coast, and Dillon had shot himself in the delirium of fever. Cameron reached Tanganyika, and there made his principal contribution to African geography—the discovery that, *at the time of his visit*, the Lukuga was an outlet from the Lake to the west. He then reached the Lualaba and descended this to Nyangwe, a point previously reached by Livingstone. Here the natives forbade his advance, they refused him boats, and his men protested: so Cameron gave it up, and struck away to the south-west to the Lomani and across the head streams of the Kassabe to Benguela, which he reached in November, 1875. During the latter part of his march his astronomical observations enabled him to fix the positions with greater precision, but the great question as to whether the Lualaba belonged to the Nile or the Congo he left exactly where he found it. Stanley arrived a little later and had just the same opposition, and was in less advantageous circumstances; but he defied the natives, seized boats when he could not buy them, coerced his men, and accomplished his mission. A comparison has often been instituted between the methods of the two men, and Cameron's peaceful tact has often been commended in contrast with Stanley's forceful ways. But it must be remembered that they were both sent out to do a certain piece of work, and that while Cameron failed Stanley succeeded. In later years Cameron explored the "hinterland" of the Gold Coast and the Niger in 1882, and also the proposed railway route to India down the Euphrates Valley, in which scheme he was a devout believer. For some years he had settled down in England, his time being mainly occupied with his work as promoter and director of several commercial companies.

JOHN JENNER WEIR.

BORN AUGUST 9, 1822. DIED MARCH 23, 1894.

ANOTHER veteran entomologist has passed away. Mr. Weir died on 23rd March at the age of 71. He was principally known as a student of the Lepidoptera, numerous papers on which have appeared by him during the last thirty years. He was one of the earliest observers to remark the now well-known connection between the colours of caterpillars and their edibility by birds, a paper on this subject having been published by him in the *Trans. Ent. Soc.* for 1869 and 1870. Students of the British fauna will recall his work on the moths of Shetland, published in the *Entomologist*, on the editorial staff of which magazine he served up to his death. Melanism and other colour problems have received elucidation by his researches, which included vertebrates—specially birds—as well as insects. In the April number of the *Entomologist* is published also his last paper—

a discussion on some genera of Limnaine butterflies, with a description of a new species from Borneo, illustrated by a boldly-drawn figure. An autobiography, with portrait, appeared in the *British Naturalist* for July, 1893.

CHARLES EDOUARD BROWN-SÉQUARD.

BORN APRIL 8, 1817. DIED APRIL 1, 1894.

THIS eminent physiologist was the son of Edward Brown, of Philadelphia, and was born at Port Louis, in the Mauritius. His mother, from whom he derived his name, was a Frenchwoman. In 1838 he went to Paris to study medicine, received his doctorate in 1840, and proceeded at once to make those researches which have rendered his name famous. He held a post for a short while in London at the Hospital for Paralytics, and from 1864–1868 he held the Professorship of Pathology and Physiology at Harvard College, United States. In 1878, he succeeded Charles Bernard in the chair of experimental physiology at the School of Medicine at Paris. Among his best-known works may be cited his researches into the composition of the blood, animal heat, the spinal cord and its diseases, and the characters of the brain. He was the founder of the *Journal de la physiologie de l'homme et des animaux*, and was its editor from 1858–1863; he directed the *Archives de Physiologie Normale et Pathologique*, with Charcot and Valpian from 1868 onwards, and in 1873 he established a practice in New York, and, with Dr. Segrim, founded and edited the American Journal *Archives of Scientific and Practical Medicine and Surgery*. He was president of the Biological Society of France in 1887.

GEORGES POUCHET.

BORN 1833. DIED MARCH, 1894.

GEORGES POUCHET was the son of Félix Archimede Pouchet, and was born at Rouen in 1833. He studied medicine at Paris, receiving his Doctorate in 1864. The year following he was appointed assistant-naturalist and chief of the anatomical department of the Musée d'Histoire Naturelle at Paris, a post he continued to hold until his death. In October, 1870, he became general secretary to the Prefecture of the Police, but soon returned to his natural history.

Pouchet published "De la pluralité des races humaines" (1858); "Précis d'histiologie humaine" (1863); "Colorations de l'épiderme" (1864); and numerous memoirs on the great ant-eater and other edentates.

THE deaths are also announced of:—Dr. WILLIAM F. POOLE, the well-known librarian of Chicago. Dr. Poole was in his seventy-third year, and had been librarian at Boston and Cincinnati before he went to Chicago to take charge of the Public Library. Since the fire

of 1871 he has organised the Newberry Library in that city. Dr. Poole was President of the American Library Association for several years. His great work, "An Index to Periodical Literature," laid a debt upon readers difficult to estimate, and it is unquestionably one of the greatest bibliographic labours of any time.

Mr. HENRY BEAN MACKESON, who died at Hythe in March last, was in his eighty-third year. He was well known as an archæologist and geologist, and was the one to discover the great Saurian in the lower greensand of Hythe, which was described by Owen as *Dinodocus mackesoni*.

We also regret to record the death of JOHN BICKERTON MORGAN, of Welshpool, one of the most promising geologists of the younger school. Mr. Morgan died of phthisis in March.

Among others who have passed away we notice the name of GEORGE PYCROFT, of Richmond, Surrey, whose death occurred at Torquay on Good Friday. Mr. Pycroft was one of the original founders of the Devonshire Association for the advancement of science and art, his chief interests being centred in archæology and art. Mrs. MARY HEMENWAY, the Boston millionaire, who employed throughout life her knowledge, experience, and great wealth in inaugurating and fostering all matters relating to social and educational progress, scientific and historical research. She is best known as a friend to American archæology, and promoted and carried through the "Hemenway Exploring Expedition" in Arizona. DR. F. ULRICH, Professor of Zoology in Hanover Polytechnic; DR. S. A. WEISS, the well-known Professor of Botany at Prague; and DR. ARTHUR HILL HASSALL, the microscopist and analyst, who died on April 9 at his home at San Remo; also swell the heavy list which we regret to have to record this month.

NEWS OF UNIVERSITIES, MUSEUMS, AND SOCIETIES.

MR. JOHN C. WILLIS has left Cambridge for Glasgow, where he takes up the appointments of "Senior Assistant in Botany" at the University, and Lecturer in Botany at Queen Margaret's College. Mr. J. Elfreth Watkins, for nine years Curator of the Department of Transportation at the National Museum, Washington, has lately left for Chicago to take charge of the Department of Industrial Arts at the New Columbian Museum. It was Mr. Watkins who arranged the remarkable exhibit of the Pennsylvania Railroad at the World's Fair. Dr. O. Mattirolo has been appointed Extraordinary Professor of Botany and Director of the Botanic Garden at Bologna. Dr. F. Dahl has been appointed Professor of Zoology, and Dr. F. Shütt Professor of Botany, at Kiel University. Mr. Walter Garstang, M.A., who was recently elected to a Research Fellowship at Lincoln College, Oxford, has resigned his post on the Plymouth Staff of the Marine Biological Association, and will leave Plymouth towards the end of May. We understand that Mr. Garstang intends to devote himself to his Fellowship researches and to the early completion of an illustrated descriptive work upon the littoral zoology of the British Isles.

A SHORT time ago the Berlin Aquarium built a Zoological Station at Rovigno, of which Dr. Hermes is Director. The internal arrangements are now so far completed that there is room for six students. Two tables are at the disposal of the German Government, two at that of the Prussian "Kultusministerium," and two at that of the Berlin Aquarium. Students may be of any nationality. We regret to learn, through the *American Naturalist*, that the Biological Laboratory founded at Milwaukee by Mr. Allis, has had to close in consequence of the hard times. The surplus copies of the five Annual Reports upon the Liverpool Marine Biological Station formerly on Puffin Island (1888 to 1892, the complete set) have been collated and bound up to form an 8vo volume of about 180 pages, illustrated with cuts and plates, and containing the original lithographed covers. Thirty copies of this volume are now offered at 3s. each nett (post free), and may be obtained from Mr. I. C. Thompson, 4 Lord Street, or Professor Herdman, University College, Liverpool.

THE Director-General of the Geological Survey is arranging at the Museum of Practical Geology a series illustrative of the submarine deposits now forming off the coasts of the British Isles. This should prove of great value and interest to all naturalists.

UNDER the auspices of that useful body, the A. W. P. L. (for which see NATURAL SCIENCE, vol. iv., p. 254) some short courses of lectures on Natural History are being given in the Natural History Museum in the Cromwell Road. These courses are specially intended for children, and are followed by rambles in the Museum. The fee for a course of six lectures is ten shillings. As the Trustees of the British Museum provide one of their public galleries for a lecture-room, as well as screens,

specimens, chairs, and the services of an attendant, it is to be hoped that the general public will benefit by this innovation, and that the A.W.P.L. will not be the only body to secure a commission on the receipts.

THE Museums Association meet this year in Dublin during the last week in June, under the presidency of Dr. Valentine Ball, C.B., F.R.S. There is every promise of a successful meeting, as a strong local committee has been formed in Dublin, and we note that the council invite the attendance of members of Museum committees as well as curators. Further information may be obtained from H. M. Platnauer, Museum, York, or E. Howarth, Museum, Sheffield.

THE Rutherford College, Newcastle-on-Tyne, which may be described, in the words of Lord Armstrong, as "a cheap working-man's college, designed chiefly for useful technical education, but intended, also, for the advancement of all pupils of excessive ability who aspire to professional life or to the attainment of academical honours," was formally opened by the Duke of York on April 5. This College, which is raised as a monument to the late Dr. J. H. Rutherford, who did so much for education among the masses, provides accommodation for 2,000 students. The Trustees have established some 30 scholarships, tenable for three years, ranging from £9 to £15 a year, and also an exhibition of £50 a year to the University of Cambridge. The building contains fine art, physical, chemical, biological, metallurgical, and engineering departments, with workshops, lecture theatre, library, and reading-room. The College is affiliated to London University, and associated with the Science and Art Department at South Kensington. A tower at one end of the building will be utilised as an astronomical observatory.

THE date of the Robert Boyle lecture at Oxford is now definitely fixed for May 8. Professor Alexander Macalister's subject, "Some Points of Morphological Interest in Human Variations," is much "on the moment," as the newest journalism phrases it. At the conversazione of the Junior Scientific Club, on May 22, Captain Lugard will speak. We thought, by the way, the Robert Boyle lecture had been founded to remove lectures from the conversazione. Professor August Weismann, who is to deliver this year's Romanes lecture, arrived in England on April 10.

THE Summer Educational Plans of Toynbee Hall, Whitechapel, contain the following alterations in the lecture list that we published last February (p. 156). Dr. Fison's subject is now "Light Waves and the Ether," while Mr. Parkyn talks on "The Tissues of the Body." On April 27, Mr. C. G. Moor begins a short course on "The Chemistry of Common Life," with practical laboratory classes. Dr. A. S. Gubb now takes a Sunday class in Physiology. The Natural History Society announces several excursions; its evening meetings are on the first Monday of each month.

THE London Amateur Scientific Society appears to have ceased publishing, but in the form of meetings at the Memorial Hall, Farringdon Street, its activity still continues. The secretary is Mr. S. Pace, 252 Fulham Road. Papers have lately been read, "On the Ascent of Water in Trees," by L. A Boodle; "On the Occurrence of Gold in Eruptive Rocks from South Africa," by G. Holbrook; and "Some facts about Parasitism and kindred Phenomena in Plants," by Jesse Reeves. On April 27, F. A. Bather is announced to discuss the vexed question, "What is a Genus?"

THE chief features of the report of the Zoological Society of London in the accounts for 1893 are an increase of £300 in cost of provisions, of £200 in menagerie expenses, and of £400 in the cost and carriage of animals. There is, fortunately, an increase of £1,600 in admissions to the Gardens, which assists in

balancing the above-mentioned and other out-payments. The mortgage debt, which is steadily reduced £1,000 a year, now stands at only £2,000. The Society hold no stocks beyond the £2,000 Davis Fund Trust.

THE report of the Epsom College Natural History Society for the year ending Christmas, 1893, reaches 86 pages, and shows evidence of considerable activity Among the lectures delivered last year we note one by Mr. J. J. H. Teall, on Silica, one on the Puss moth, by Mr. O. H. Latter, and a third, on Captures of a Tow-net, by Dr. Hudson. Numerous excursions were made in the district round Epsom, a method of instruction upon which it is impossible to lay too much stress. Lists are given of the birds, plants, and lepidoptera of the district, with notes on their earliest observed occurrence. The system of giving a prize for the best lecture or essay, delivered by a member of the school during the year, is an excellent one, and tends to stimulate research and accuracy. Last year the prize was won by Mr. H. Mayo, for his paper on "Evolution." This year the subject selected for competition is "The Life and Work of Darwin." Might we suggest that subjects of more local and less cosmic interest would better bring out the scientific capabilities of our intelligent youth?

FROM the Sixty-ninth Annual Report of the Norfolk and Norwich Museum we learn that the glass cases are almost completed. The departments of Ornithology, Mammalia, and Ethnology have been enriched by important additions, among which may be mentioned: a series of specimens from the bank of the Amazon; an adult skull of *Hippopotamus amphibius*; twenty-two specimens of birds of prey from Mr. J. H. Gurney; and numerous animals of local interest and rarity, including the adult female of the great Bustard (*Otis tarda*) referred to in Stevenson's "Birds of Norfolk" (vol. iii., p. 401), which now permits the exhibition in the Museum of an unequalled group of these birds. A full account of the Norfolk and Norwich Museum from the pen of Dr. Henry Woodward appeared in this Journal for November, 1892. The twenty-fifth annual meeting of the Norfolk and Norwich Naturalists' Society was held in the Museum, Norwich, on 27th March, the president (Mr. T. Southwell, F.Z.S.) in the chair. In reading his address, Mr. Southwell remarked upon the publication in the Society's *Transactions* of very valuable records of the local fauna and flora, and of the biographical memoirs of Norfolk naturalists, among the more interesting of which we recall those of C. B. Rose and Samuel Woodward. The series of letters from Gilbert White to Robert Marsham, of Stretton, were also referred to, as well as the endeavours of the Society to prevent the wanton destruction of rare and interesting birds that occasionally visited the country. The full strength of the Society is 226, and despite the heavy cost of printing the *Transactions*, it is now in a fairly prosperous condition. Mr. Southwell then gave a sketch of the avifauna of Norfolk, and the pastoral value of its soil. Dr. Charles Plowright was elected president in succession to Mr. Southwell, and Professor Collett and Mr. E. T. Newton were elected honorary members.

WE note the following papers in Publications of British Societies. The December number of *Timehri*, the journal of the Royal Agricultural and Commercial Society of British Guiana, contains a paper by the editor, Mr. Rodway, on the history of the Society for the first two years of its existence. The writer notes that the 18th March, 1894, was the fiftieth anniversary of the foundation of the Society. The excellent work of the Society in furthering the agricultural and commercial interests of the colony is touched upon, and attention is called to the importance of the Museum and Library, and the large collection of newspapers and magazines to be found in the reading room. No more interesting work can be done by the editor of a fifty years' old Colonial journal than to give a sketch of this kind, for the present generation are apt to forget the names of those who founded, and of those who carried successfully on, a Society which has stimulated such good work and provided so much entertainment for those whose interests lie in the development and

advancement of their working field. Another paper of value in this number is that of the Rev. W. B. Ritchie, on "The First Thirty Years of Schools and Schoolmasters in British Guiana." The *Proceedings of the Dorset Natural History and Antiquarian Field Club*, for 1893, has been issued. Mr. Mansel-Pleydell's Presidential Address deals chiefly with the geological distribution of plants, and forms a useful synopsis of the subject. Mr. S. S. Buckman discusses the Inferior Oolite and its subdivision into zones; while the President adds a further note on the Dewlish "Elephant Bed," with photographic illustrations. The Rev. O. P. Cambridge continues his valuable reports on new and rare British spiders, and the Rev. R. P. Murray gives a coloured illustration of his new bramble, *Rubus durotrigum*, described two years ago in the *Journal of Botany*. The other papers are of archæological interest. The Royal Society of South Australia has issued the second part of vol. xvii. of its *Transactions*. The papers are mostly of a systematic nature, dealing with Galls, Rhopalocera, Heterocera, Coleoptera, and Tertiary Gasteropoda; but two papers by W. G. Stretton and Rev. D. Mackillop give a most interesting account of certain aboriginal tribes in the Northern Territory of S. Australia. One of the most useful branches of this flourishing Society is a committee for the protection of the native fauna and flora, many species of which are in great danger of extermination. Among the many interesting papers in the second number of the *Proceedings of the Malacological Society of London*, mention must be made of the useful paper on British Chitons, by Mr. E. R. Sykes; an excellent plate is given, and the student should now have little difficulty in identifying his finds. A similarly valuable paper has just been published by the Geologists' Association (*Proceedings*, vol. xviii., p. 190), by Mr. Smith Woodward, on "Sharks' Teeth from British Cretaceous Deposits." This paper is also well illustrated, and will enable many an amateur geologist to identify his Chalk finds without worrying a Museum curator. Dr. H. B. Guppy has a paper on the Temperature of Rivers in the last number of the *Proceedings of the Royal Physical Society of Edinburgh*. Only part i. has yet appeared, and deals with the daily changes and method of observation.

AT the twelfth annual meeting of the American Society of Naturalists, held at Yale University, December 27 and 28, 1893, a committee was appointed to appeal to Congress for the repeal of that tax upon knowledge which is embodied in the Customs duties on instruments of research. It was pointed out that these duties were not needed for the protection of the American manufacturer; for at least one American firm was ready to sell its goods at a price a little below that of the foreign manufacturers to those institutions that could already obtain duty-free prices, while for all others it added the extortionate 65 per cent. of the present tariff. In the interests of science we wish the committee every success. The American Society of Morphologists held its annual meeting at New Haven on December 28 and 29, 1893, while the American Physiological Society was holding its sixth annual meeting at the same time and place. These two Societies have entered a movement of closer co-operation among the leading American scientific Societies, headed by the Society of Naturalists. It is hoped that the Psychologists and Geologists will also join. Co-operation is admirable; but the immediate result appears to be the formation of something like a second American Association for the Advancement of Science.

IN the March issue of the *Botanical Gazette*, Mr. F. C. Coville, botanist to the U. S. Department of Agriculture, states that the Department has inaugurated a seed collection in connection with the National Herbarium, which is intended to include seeds of all the species of plants obtainable, especially weeds and forage plants The seeds, when not too large, will be placed in flat-bottomed specimen tubes, which will be labelled, and arranged systematically in covered trays made of binder's board. Fleshy fruits of native American plants will be put into similar bottles filled with a preserving liquid. Authentic herbarium specimens of plants raised from the seeds represented, or of plants from which the seeds were obtained, will accompany the

collection whenever possible. The Division of Botany also proposes to undertake the testing of various seeds as to purity and germinative powers, for which purpose a laboratory will be fitted up and equipped after the most approved methods of American and European seed control stations. Physiological experiments connected with germination and development will be conducted both in the laboratory and the open air. Histological studies may ultimately be made of the structure of the seeds of American weeds and forage plants, partly with the view to elicit facts of taxonomic value. The entire work will be carried on with special regard to its economic importance, while the collection will be useful for reference. Mr. G. H. Hicks, recent instructor in Botany at the Michigan Agricultural College, has been placed in charge of the matter.

It will be remembered that, some time ago, the appropriation voted by Congress towards the United States Geological Survey was materially reduced. From Major Powell's annual report we glean the following results of this reduction. During the early part of the fiscal year the field parties engaged in geological work were entirely reorganised. A large reduction of the force employed in palæontological work was made necessary, and several former divisions were consolidated into one division, in charge of the chief palæontologist. The division of illustrations was dissolved at the opening of the year, and then re-organised, with a force of seven persons. The total expenditures of the survey for the year amounted to $423,022, against an appropriation of $430,073. It is interesting to note that, despite the reduction, much work, of great economic value to the nation, has been done on the running waters of the country. Steps are already being taken, it is stated, to use at least the smaller streams for water power and irrigation. A rough computation, based on the stream measurements and census figures, indicates, it is cited, that the running streams of the arid region, when all are used, will have a value of at least $600,000,000. Those who know the secret of the reduction of the grant will find food here for sweetly ironical reflections.

In November last we announced that Mr. W. F. E. Gurley had been appointed State Geologist of Illinois, and we feared that the palæontological work of the State would be entrusted to the well-known and prolific author of new specific names, Mr. S. A. Miller. Our worst anticipations have been realised. The Illinois State Museum of Natural History has published as its *Bulletin* no. 3 a "Description of some New Species of Invertebrates from the Palæozoic Rocks of Illinois and adjacent States" by those two writers. This appears equal to their previous work, and therefore needs no criticism. We merely wish to point out that fifty-eight new species are here described in a State publication, under the name of a State official; but that only four of the type specimens are in the State Museum, the remaining fifty-four being in the private cabinets of the two authors. "It requires neither information nor study to propose specific names" (p. 55); but the type specimens gain in pecuniary value even when the species are worthless.

Kansas University appears to have undertaken the work of a Geological Survey during 1893. Professor Erasmus Haworth organised a class of three who studied the stratigraphy of the south-eastern part of the State. Nearly 600 miles of sections were made and much other work accomplished, a report of which will be found in the *Kansas University Quarterly* for January, 1894. Enthusiastic students are always to be found among the young; this method supplies them with what they chiefly lack—organisation and experience.

The United States Government are fitting out an expedition to explore the region of the north magnetic pole. This spot, which lies on the western point of the Isle of Boothia Felix, near Cape Adelaide, has only been described once, when Ross's expedition discovered it, and a great deal of curiosity is felt as to whether it will have shifted at all during the last sixty-five years.

CORRESPONDENCE.

A Whale Fight in 1240.

In reference to Mr. R. Lydekker's account of a whale fight in the South Atlantic, printed at p. 173, it may be of interest to quote the account of a whale fight which occurred in 1240, probably near the mouth of the Thames, as given by Matthew Paris, the chronicler of St. Albans, in his *English History*.

A.D. 1240.—"*A Remarkable Battle amongst the Fishes of the Sea.*—Although other great and unheard-of wonders happened in this year, we have thought it worth our while to mention in this work one more remarkable than the rest. As it is the nature of the sea to vomit up on dry land the dead bodies thrown into it, about eleven Whales, besides other marine monsters, were cast up on the sea coast of England dead, as if they had been injured in some kind of struggle, not, however, by the attacks or skill of man. The sailors and old people, dwelling near the coast, who had seen the wonders of the deep when following their vocation in the vast waters, and trafficing to distant countries, declared that there had been an unusual battle amongst the fishes, beasts and monsters of the deep, which by wounding and gnawing each other, had caused death to several; and those which had been killed had been cast ashore. One of the fishes, a monster of prodigious size, made its way into the Thames, and with difficulty passed uninjured between the pillars of the bridge; it was carried as far as a manor of the king's called Mortlake, where it was followed by a number of sailors, and at length killed, after a great deal of trouble by innumerable blows of spears."

Dunstable. Worthington G. Smith.

An Ammonite Problem Solved (?)

With reference to our note with this title (p. 245), Mr. S. S. Buckman points out to us that a distinction should be drawn between "beds which only yield worn and imperfect specimens," and "beds which afford specimens in a complete state of preservation, the shell-sculpture remarkably sharp, and the delicate mouth-processes complete." In the former cases "distribution is readily granted"; but in the latter "it is reasonable to conclude that there has not been much distribution after death."

While admitting some such caution, we may, nevertheless, suggest that the shell of *Spirula* is a sufficiently delicate structure, and that distribution by flotation would not really expose the shells to many casualties.

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